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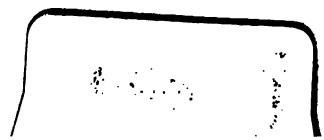

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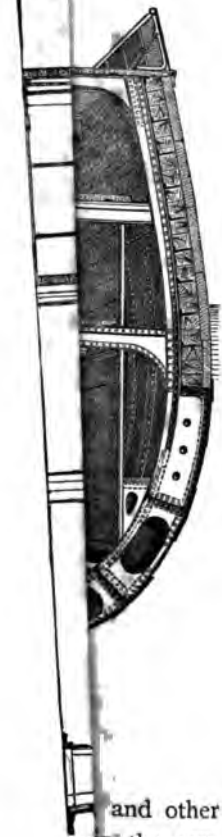

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CAPTAIN ALSTON'S

SEAMANSHIP.

NEW EDITION,

REVISED AND ENLARGED BY

COMMANDER R. H. HARRIS, R.N.;

WITH A TREATISE ON

NAUTICAL SURVEYING,

BY

STAFF-COMMANDER MAY,

F.R.G.S;

ALSO,

INSTRUCTIONS FOR OFFICERS OF THE MERCHANT SERVICE,

By W. H. ROSSER.

With Two Hundred Illustrations.

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TO

THE JUNIOR OFFICER'S OF THE NAVY,

This Work,

WRITTEN FOR THEIR GUIDANCE,

IS INSCRIBED BY

THE AUTHOR.

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PREFACE TO SECOND EDITION.

BY COMMANDER R. H. HARRIS, R.N.

IT will, I believe, be generally acknowledged that the few years which have elapsed since the first publication of this book have seen not only greater, but far more distinct changes in the build and rig of Her Majesty's ships than at any previous time in the history of the service since Alfred the Great organized his fleet: and, indeed, now are these changes going on with such rapidity, that the fighting ship of the day (with her many inches of armour and powerful battery) is hardly commissioned, before a ship of so much the greater offensive and defensive power is designed, which would, according to all reasonable calculations, take or sink the former in half-an-hour.

In like manner, though perhaps in a less degree, are continual and ever varying changes being made in the rigging and ordinary fittings of the *hull*, to suit the peculiar form and distinctive features of each new description of vessel. Having this difficulty to deal with, it will be seen that I have found it impossible to notice all the novel

fittings which are to be seen in individual vessels, though I have endeavoured to select the more important of them and those most likely to be permanently adopted.

In the revision of this work—while introducing much that is new,—I have of necessity been obliged to omit many things that have become obsolete, and to modify other things to meet the custom or requirements of the present day. I have adhered as closely as possible to the original plan of publication adopted by my friend, and old instructor the Author; but I regard *steam* as the motive power, and *sail* as the useful auxilliary only, for a man-of-war.

The subjects now required to be attained before an embryo can hope to be a proficient naval officer are so multifarious, and the general and steadily increasing use of steam power is rendering opportunities of acquiring a practical knowledge of Seamanship so scarce, that it is very certain books will become of more importance than ever as vehicles of instruction, to assist officers in obtaining that sound knowledge of their profession, which, combined with valour, under God's providence, has made the British Navy renowned in the annals of the world.

R. H. HARRIS, COMMANDER, R.N.

January, 1871.

INTRODUCTION TO FIRST EDITION.

BY CAPTAIN ALSTON, R.N.

ALTHOUGH we are living in what may be called the Steam era, and our Navy is a Steam Navy, I have in this work wholly excluded the consideration of Steam power, as, owing to the great cost of coal, and the impossibility of providing stowage for it except to a limited extent, the application of Steam power for ordinary purposes must be strictly auxilliary and subordinate, and its employment on general service the exception and not the rule. In bad weather the old order of things will re-assert its supremacy, and any lengthened absence from port, or derangement of machinery, must always render the use of canvas imperative.

Thus, then, the study and practice of seamanship are happily not yet a work of supererogation. If Britannia be destined still "to rule the waves," it must be by the help of seamen as well qualified as those who won that supremacy for her; and we trust that the day is far distant, when her trident shall be delivered into the keeping of mere artillerists and mechanical precisians.

The chapter on nautical surveying is intended for the use of those officers, who not having had any experience in surveying operations may unexpectedly find themselves in a situation where such work is expected from them; and will be found to embrace every useful application of the subject that can possibly be required for common purposes.

The interrogatory form has been adopted in order to bring prominently into view such particulars as might escape the notice of the student in a continuous composition, and the questions being separated from the explanatory part of the work will enable those who feel desirous of improving themselves to *write out* their own methods and solutions, without having mine thrust before their eyes, and thus to think and judge for themselves. It has not been my object to enter into the whole details of a ship's equipment—to state how *all* the ropes are led, nor how *everything* is fitted, as such I conceive would have a mischievous tendency by becoming subservient to the wants of the indolent and unobserving; my endeavours have been thus purposely limited by an earnest desire to give a helping hand to such as are willing to assist themselves, and to render the various subjects treated of clear to those who are anxious to learn, and who will take the necessary trouble to understand them. Probably my treatment of some matters will prove to be faulty, and, as I am very desirous to remedy such inaccuracy by correction in a future edition, I shall be grateful to any one who will take the trouble of pointing out any errors they may detect, by communicating with me on the subject, through the publishers.

I may indulge the hope that, by the presence of this volume in the gun-room, useful discussion will be promoted, and consequently an increased interest be taken by young officers in their professional duties, and I trust, moreover, that none of my readers will be influenced by the silly outcry against "talking shop," which, of late years, it has been the fashion of young gentlemen to denounce. For such, I do not write; but, on the other hand, the more forcibly would I urge upon those who are desirous of excelling in their profession, the duty of giving to it a hearty acceptance, and a resolute attention, for it is a service that may worthily claim the exercise of the most vigorous

qualities, both physical and intellectual. Therefore, I would say to young officers individually,—master your duties as soon as you are able; be up to your work on all points within your reach, so that you may be relieved from all those doubts and anxieties which ignorance and hesitation are sure to produce. If true to your calling you cannot be too hopeful, and sooner or later you will meet with opportunities which, if you have the talent to take advantage of them, will lead to the realization of every reasonable desire. Very admirable and worthy of attention is the advice of Sir Walter Scott upon this point:—"I have rarely seen," he says, "that a man who conscientiously devoted himself to the studies and duties of *any* profession, and did not omit to take fair and honourable opportunities of offering himself to notice, when such presented themselves, has not at length got forward. The mischance of those who fall behind, though flung upon fortune, more frequently arises from want of skill and perseverance. Life is like a game at cards; our hands are alternately good or bad, and the whole seems at first glance to depend on mere chance. But it is not so, for in the long run the skill of the player predominates over the casualties of the game. Therefore, do not be discouraged with the prospect before you, but ply your studies hard, and qualify yourself to receive fortune when she comes your way."

Lord Dundonald, the equal of Nelson in valour and in genius, when commander-in-chief of the Chilian navy, had to take off his coat, and with his own hands mend the pumps, on an occasion when the water was gaining on the ship, and his carpenter was incompetent to repair them. And as I hold that "a good mariner ought to have all knowledge of carnal and worldly cunning, even to tailoring and shoe-making, that he may be able to turn his hand to whatsoever may hap," so I have explained how scrubbing-brushes and sennit hats are made, and many other things which no officer should consider it above his duty to be well acquainted with. They who have seen seamen and soldiers thrown together upon their own resources, and have contrasted the working of their respective systems, will be able to appreciate the importance of this principle in the education of officers.

Forebodings of great wars, every now and then, fill with anxiety the

minds of all thinking men. We feel convinced of the terrible necessity which exists for preparing for the worst, and intimately as this important question affects us, I would say something to my young readers upon it, in order to direct them to the only true principles upon which their efforts, should they be called for, can successfully be based. More particularly am I desirous of doing so here, as the majority of works of a preceptive character that are put into their hands seem to overlook the fact that, to develop the military faculty, and to render them supreme in *War* is the most immediate object of their training. Let gentlemen of the Navy bear in mind that the ship in which they sail is called a man-of-war; that they and the crew are continually exercised in cutlass, gun, and rifle practice, and all other modes of fighting—and for this one purpose surely, that they may be able to fight. The maintenance of peace, which should be the ultimate object of our efforts, can only be ensured, as all experience proves, by our being in constant readiness in war. Keeping this in view, we may then, and only then, turn our thoughts to the duties required of us in time of peace; which, to our men, consist in doing as we would be done by; cordially recognizing and providing for those capacities for enjoyment which find expression in such common things as "beer and skittles," but which nature will resist every attempt to repress; treating every man as honest until he prove himself a rogue; and in all things ruling ourselves and them as becometh good, wise, and temperate Christian gentlemen; to become which should satisfy the ambition, and be honour enough for any man.—Furthermore, by our influence and example to promote the cause of law, order, commerce—and last, but not least, of Christianity on foreign stations; all of which is just as noble as fighting—and nobler if you will think, because it obtains the ends of fighting without the ugly means.

Meanwhile, until this responsibility of government falls upon you, be content to learn obedience chiefly; for the powers that be are ordained of God. Do your daily work, as unto God, and not unto man only; and remember with George Herbert—

> "Who sweeps a room, but for Thy sake,
> Makes it, and the sweeper, fine."

If we should be called upon to resort to war in order to keep the peace, or "keep the seas" as it was called, God send you the ancient righteous spirit which animated pre-eminently the old Judæan warriors. No thought for their life took they, nor for aught but the stern work before them: all that concerned them to do or to think was comprised in two short sentences: "Let us behave ourselves valiantly for our people, and for the cities of our God: and let the Lord do that which is good in His sight." This was the pith of their sturdy creed in the days of their glory, when all invincible, they were led to battle by David, "the anointed of God." Those long lists of "mighty" and "most honorable" men, who won their cross of valour three thousand years ago, were written for our learning, and have been preserved as incentives to us when the chivalrous feeling waxes cold within us; and you cannot, indeed, as a man bred to arms, read the simple record which brings those old-world heroes before us, without feeling the stronger and the better for it; bewaring, though, lest we should cherish cruelty, ferocity, or pride thereby, to end as those very Jews did, in being hateful and haters of all mankind, believing that God hated every one but them, till the heathen Roman empire had to rise and crush them, as a dehumanized nuisance to the world.

In the quiet time of peace you will not feel the full force of this admonition, nor appreciate the need for storing your mind with such examples against a darker day; but rely upon it that the hour comes in every man's experience, when he feels the deep want of some precedent which he can unhesitatingly follow and trust to: and you, when you come to face death in the dread work of war (in which we know not how soon we may be involved), will feel your heart lightened, your reason strengthened, and your arm guided by unseen hands, if as an amulet you carry with you the unchangeable truth, taught in these ancient chronicles. These scriptures if they have any meaning at all for us, are meant to furnish the examples needed to form the character of a man whose occupation in life it is in the present day to fight the Queen's enemies; and the same Spirit of God, who so strengthened their hearts, and "taught their hands to war and their fingers to fight," caused their histories to be written as a

pledge and an assurance of His mighty aid to men who, in His strength, go forth, fulfilling a noble duty, to fight for their country, Queen, religion, and honour, against the enemy, be he who he may.

Though distorted, this teaching was not forgotten in the age of chivalry, at the time when,—

"Our stout crusading fathers
Fought and died for God, and not for gold."

Above all, it was not forgotten by the sea-captains of the Elizabethan era, and the scarcely less glorious one of the Commonwealth, who fought and conquered, and wrought deeds of daring beyond belief, with the "praises of God in their mouth, and a two-edged sword in their hands." "Men of heroic courage, marine worthies, beyond all names of worthinesse," teach this faithless age the secret of your greatness! Of him whose motto was, "multare vel timere sperno," we have but a glimpse,—the raging storm, the puny vessel, the open book, and the cheering cry, when the sea was "breaking short and pyramid-wise,"—"We are as near to heaven by sea as by land." "We cannot doubt the book which Sir Humphrey Gilbert, "giving forth signs of joy," read that afternoon before they foundered, on the deck of his ten-ton "frigate." There lay the secret, the "secret of the Lord," which all the noble-hearted men of that day knew; and they were no lachrymose devotees, but bold, uncompromising, resolute men, who feared God, but who feared neither man nor devil besides. Read Barrow's "Life of Drake," young gentlemen, and that of Blake, by Hepworth Dixon; and if you have any worthy longings in your hearts, you will there find abundant encouragement to sustain them, and a high-souled example to direct them.

To give you an insight into the character of men of this stamp, I cannot do better than epitomize the life of Drake:—

This renowned Englishman first distinguished himself in Hawkins's expedition to the West Indies in 1567, when they took Rio de Hacha by storm, on the Spaniards refusing to trade; and then, sailing on to San Juan d'Ulloa, entered the port, in which lay twelve ships, having on board £200,000 in gold and silver, but which Hawkins forbore to touch, as we were then at peace with Spain. The extraordinary sequel is well known, and it shows the dread in which the English name must have then been held. A Spanish fleet of thirteen great ships appeared off the

port; Hawkins, who had only four ships with him, lying at the time, be it remembered, in a Spanish harbour, protected by a battery of brass guns, with the twelve ships of the enemy before mentioned, had the boldness to refuse an entrance to the Spanish fleet until they had promised to maintain peace, and allow him, during his stay, to keep possession of the island on which the battery was placed. Hostages were exchanged, and, we are told, "at the end of three days the Spanish fleete entered the port, the ships saluting one another, as the manner of the sea doth require." While thus "promising great amitie on all sides, the faithlesse Spanyards presentli brought a great hulk,' moored her alongside the "Minion," and in the night filled her with men; and when everything was prepared, surprised the English. At a given signal, 300 men were poured into the "Minion;" "whereat our generall (Hawkins) with a loude and fierce voyce called unto us saying, 'God and Saint George! upon those traiterous villaines, and rescue the "Minion," on which he, with his men, leaped on board and drove out the Spaniards. The fight then became general, and continued until night. The "Jesus of Lubeck," Hawkins's ship, having her masts shot away, and being "wonderfully pierced with shotte," they were obliged to abandon; and the Spanish admiral being supposed to be sunk, the vice-admiral burnt, and some other ships destroyed, they made their escape with their only two remaining ships, one of which was Drake's fifty-ton bark, the "Judith;" and after undergoing great hardships, returned to England.

Having fitted out *two small ships*, Drake, on Whitsun eve, 1572, "set saile from out of the Sound of Plymouth with intent to land at Nombre de Dios"—then the great storehouse and shipping place for all the gold and silver collected in Mexico and Peru. Before sailing, he had provided himself with "three daintie pinnaces, made in Plimouth, taken asonder all in pieces and stowed aboard." These he set up at Santa Martha, where he left the ships, and with seventy-three men started for the Spanish settlement. Stealing upon Nombre de Dois at night, he surprised the town, marched to the governor's house, the door of which was open, and a light burning on the stairs; by the light they saw a vast heap of silver piled against the wall, as nearly as they could guess, seventy feet in length, ten in breadth, and twelve in height. Soon after landing, Drake had received a severe wound, but which he concealed for some time, "knowing, if the general's heart stoops, the men's will fail; and that if so bright an opportunity once setteth, it seldom riseth again." However, he fainted from loss of blood, and was carried down to the boats. "Divers of his men, besides himself, were wounded, though but one, and he a trumpeter, slain. Many of them got good booty before they left the place. But the wines in a Spanish ship, which they found in the harbour, they took along with them for the relief of their captain and themselves. They carried off their prize to an island, which they called the Island of Victuals, where they stayed two days to cure their wounded men, and refresh themselves in the gardens they found there, abounding with all sorts of roots, fruits, poultry, and other fowls no less

strange than delicate." Having taken several prizes, he took with him eighteen English and thirty Indians, and set out by land for Panama. On his way he ascended a "goolie and great high tree," and clearly discerned the great Pacific Ocean, whereupon, falling down there upon his knees, he besought God "to give him life, and leave, once to sail an English ship in those seas," and, adds the historian, "he was heard in what he asked, as will hereafter appear." After some daring attempts with a mere handful of men to intercept the gold trains in their route to the coast, he resolved to return, and arrived at Plymouth on Sunday, the 9th of August, 1573. The news of Drake's arrival being taken into church, all ran out "to see the evidence of God's love and blessing towards our gracious Queene and countrey, by the fruite of our captaine's labour and successe. SOLI DEO GLORIA."

The next voyage was that in which he, the first of Englishmen, "ploughed a furrow round the world." With five vessels, the largest of which was his own—the "Pelican" of 100 tons, he sailed out of Plymouth Sound, December 13, 1577. On their arrival at Port St. Julian, Patagonia, Mr. Doughty, one of the gentlemen volunteers, was, as Camden, the oldest and most respectable of all Drake's historians, relates, "called to his trial for raising a mutiny in the fleet, found guilty by twelve men, after the English manner, and condemned to death, which he suffered undauntedly, being beheaded, having first received the holy communion with Drake." Hakluyt, Drake's contemporary, gives a similar account, and tells how, after the execution, Drake "made divers speeches to the whole company, persuading us to unity, obedience, love, and regard of our voyage; and for the better confirmation thereof, willed every man the next Sunday following to prepare himself to receive the communion, as Christian brethren and friends ought to do, which was done in very reverent sort, and so with good contentment every man went about his business." Thus, with solemn ordinances, and in Christian charity, this man, who is now spoken of by some as a ferocious buccaneer, "organized on that wild shore, a judgment-hall more grand and awful than any most elaborate law court, with its ermine and black cap, and robes of ceremony for mind as well as body; but which is not to be reconciled with the pirate theory, which we may as well henceforth put away from us."

After getting through the straits of Magelhaens, he parted from all his squadron in various gales, and coasting along, reaching Callao alone, where he found thirty ships of the enemy lying; all of which he deliberately searched. Out of one they took 1,500 bars of silver. He there received intelligence, and went in chase of the "Cacafuego," termed "the great glory of the South Sea"—boarding a brigantine on his way, out of which he took eighty pounds weight of gold, and some emeralds. On coming up with the "Cacafuego," he boarded and carried her. Besides a large quantity of pearls and precious stones, they took out of her eighty pounds weight of gold, thirteen chests of coined silver, and rough silver enough to ballast a ship. He at last sailed away westward, passed the Celebes without accident, but

shortly afterwards struck on a rocky shoal. The water was so deep on either side as to render it impossible to lay an anchor out to heave off by, so the ship's company were summoned to prayers—"commending ourselves into the merciful hands of our most gracious God; for this purpose we presently fell prostrate, and with joined prayers sent up to the throne of grace, humbly besought Almighty God to extend his mercy unto us in his son Christ Jesus." This done, they set to work to lighten the ship, and at low water she slid off the ledge of the rock, "and it pleased God that the wind, formerly their mortal enemy, became their friend."

On the 26th of September, 1580, "we safely," says the narrative, "with joyful minds and thankful hearts to God, arrived at Plimouth, the place of our first setting forth, after we had spent two years, ten months, and some odd days beside, in seeing the wonders of the Lord in the deep, in discerning so many admirable things, in going through with so many strange adventures, in escaping out of so many dangers, and overcoming so many difficulties, in this our encompassing of this nether globe, and passing round about the world.

Soli rerum maximarum Effectori,
Soli totius mundi Gubernatori,
Soli suorum Conservatori,
Soli Deo sit semper gloria."

Of Drake's raid on the West Indies, and the taking of St. Domingo and Carthagena; of his expedition to Cadiz, which he termed "singeing the king of Spain's beard;"—of his services in the defeat of the "Invincible Armada," against which he was second in command;—and, of his expeditions to Corunna, and to the Spanish colonies, you must read for yourselves; but, as an example of how he, whose "name was a terror to the French, Spanyard, Portugall, and Indians," was wont on all occasions to speak of his dependence upon God, I must take leave to quote a passage from one of his letters to Sir Francis Walsingham, Secretary of State, during the Cadiz expedition. After reporting the successful result of "dyvers combatts with the Spanyards and Portyugalls," he says, "God mak us all thanckfull agayne and agayne that we have, althowghe it be littell, mad a begennyng upon the cost of Spayne. If we can thorowghly beleve that this which we dow is in the defence of our relygyon and contrye, no doubt but our mercyfull God for his Christ, our Savyour's sake, is abell, and will geve us victory, althowghe our sennes be reed. God geve us grace we may feare hym, and daylly to call upon hym, so shall nether Sattan, nor his menesters prevayell agaynst us."

This living faith in a living, personal God, and belief in an actual personal devil, shows itself everywhere in him, equally with the other men of that period. Their fuller acquaintance you may cultivate at your leisure in Barrow's "Naval Worthies," and in the publications of the Hakluyt Society, where their imperishable actions lie recorded

"for the stirring up of heroick spirits to benefit their countrie, and eternize their names by like noble attempts."

Concerning lion-hearted Sir Richard Grenville you will find something hereafter. Of Sir Martin Frobisher, judge by the following articles in the regulations drawn up by him for his third voyage in 1578:—

"Art. 1.—*Imprimis.* To banishe swearing, dice, cards-playing, and all filthie talk, and to serve God twice a daie with the ordinarie service, usuall in the Church of England; and to clear the glasse everie nighte, according to the oulde order of England.

"Art. 8.—If any man in the fleete come upon another in the nighte, and haile his fellowe, knowinge him not, he shall give him this watche worde, 'Before the world was God;' the other shall answer, if he be one of our fleete, 'After God came Christ, his sonne.' Soe that if any be found amongst us, not of our own companie, he that firste descrieth any such saile or sailer shall give warning to the Admyrall."

Pause as you read these instructions of Sir John Hawkins to one of his little squadrons; mark the shrewd wisdom, and rare tenderness withal, that these few words display; and the contrast they present to the hard materialism of this our intellectual age. "Keep good company; beware of fire; serve God daily; and love one another."

The regulations for Luke Fox's voyage commence thus: "For as much as the good success and prosperity of every action doth consist in the due service and glorifying of God, knowing that not only our being and preservation, but the prosperity of all our actions and enterprises do immediately depend on his Almighty goodness and mercy, it is provided—

"First. That all the company, as well as officers and others, shall duly repair every day twice at the call of the bell to hear public prayers to be read, such as are authorized by the Church, and that in a godly and devout manner, as good Christians ought."

Without citing any further instances, it will be seen what a wholeness there was in the character of our warlike ancestors; and, notwithstanding their manifold temptations, how near to the gates of heaven

they really lived. Their greatness we may rest assured we shall never reach, until we condescend to walk in the same relation to God as they did, and have grace to understand, and sense to turn to practical use the fact of all facts, that the Son of God died for all, that they which live should not henceforth live unto themselves, but unto Him who died for them, and rose again. The rejection or neglect of this is at the root of all the failures and misfortunes of men and nations; and the reception of, and conformity to it must form the basis of all our attempts to do our work in life well, and the ground of all our hopes of being kept from going wrong, and of having the wit to do the right thing, on every occasion, of every day.

When we listen to the experiences of men of action; such as Drake, Davis, and others of that stamp, who speak with knowledge, *of* a thing, instead of with knowledge *about* it, they come with an impressiveness such as is attached to no other utterances; so that, if what they are meant to teach us fall dead upon our ears, neither should we believe if—any greater testimony were conceivable or possible. By their trust in God, and omission of no prudent means for insuring success, they made their age the heroic age of England, and endued it with imperishable life and beauty. They trusted in God, and God fought for them, and, to their minds, as palpably as on that day when He hearkened to the voice of a man: "Sun, stand thou still upon Gibeon; and thou, moon, in the valley of Ajalon." In more than mortal strength Grenville and his hundred Englishmen, in a single ship, deliberately waited for, and fought for fifteen hours a fleet of fifty sail, manned by above ten thousand Spaniards. "As thy days, so shall thy strength be,"—this he believed who, careful for nothing, performed that desperate act of valour, which, even in those days, filled the world with wonder and astonishment. And when, shot through and through, dying among Spaniards, he cried out,—"Here die I, Richard Grenville, with a joyful and quiet mind," he found God's grace to be, even in his last extremity, sufficient for him.

"Of such stuff," writes Froude, the historian of the Tudors, "were the early English navigators; we are reaping the magnificent harvest of their great heroism; and we may see once more in their history,

and in what has arisen out of it, that on these deep moral foundations, and on none others, enduring prosperities, of what kind soever, politic or religious, material or spiritual, are alone in this divinely-governed world permitted to base themselves and grow. Wherever we find them they are still the same,—in the courts of Japan or of China, fighting Spaniards in the Pacific or prisoners among the Algerines, founding colonies which by-and-by were to grow into enormous trans-atlantic republics, or exploring in crazy pinnaces the fierce latitudes of the polar seas, they are the same indomitable, God-fearing men, whose life was one great liturgy. 'The ice was strong, but God was stronger,' says one of Frobisher's men, after grinding a night and a day among the icebergs, not waiting for God to come down and split them, but toiling through the long hours, himself and the rest fending off the vessel with poles and planks, with death glaring at them out of the ice rocks, and so saving themselves and it. Icebergs were strong, Spaniards were strong, and storms, and corsairs, and rocks, and reefs, which no chart had then noted—they were all strong, but God was stronger, and that was all which they cared to know.* * * They were of a race which has ceased to be. We look round for them and we can hardly believe that the same blood is flowing in our veins. Brave we may still be, and strong, perhaps, as they, but the high moral grace which made bravery and strength so beautiful is departed from us for ever." Let us pray not!

We all hold in a certain loose way that God's favour is—not indispensable exactly, but still at least a furtherance to success. But, weak and stunted as such a faith is, we do not even act up to it, but by force of habit and the devil's influence, attach more importance to gunnery than ever we do to godliness. We have not been so uniformly successful in our late campaigns as to be induced to rely, altogether confidently, upon our own efforts; and, as Englishmen, we may ask ourselves what place we should hold among the nations, ever eager for our overthrow, if God were to forsake us. We trust to the inherent bravery of our race, forgetting from whom we derive it; and, because we have hitherto been spared the humiliation to which every other country in Europe has been subjected, we cling to the conceit

that with our wealth and our resources, we can continue, unsupported, to brave the world in arms. These extraneous advantages are but contingent on our allegiance to Him from whom we derive them. He who overthrew the ancient empires of the world, and humbled the godless kingdoms and republics of modern times, will, despite our fleets and armies, bring sorrow upon us if we seek not his guidance in all we do. Let us then, as Cromwell bade his Ironsides, "Trust in God, and keep our powder dry;" make trust in God our first consideration, and then gunnery and seamanship, skill to acquire them, courage to apply them, and all needful things will be added thereto.

The fear of *risk*, and the dread of *responsibility*, paralyzing scruples of modern introduction, will vanish before that faith through which the holy men of old "out of weakness were made strong, waxed valiant in fight, turned to flight the armies of the aliens." Under the influence of this manful spirit (which developed itself in no mere mild amiabilities, but in daring enterprises among icy solitudes, where, as the Arabs say of the desert, "There is nothing but He;" upon unknown seas which led they knew not where, and in constant fight, at all risks, and wherever they could meet with their hated foes), the men of Elizabeth's reign were saved from these appalling bugbears, which are now so terrible to all weak souls. Such *rash* things, too, did they without thinking of the consequences, as would horrify our ancient ladies now-a-days. Overleaping the exact boundaries of duty, their ardent energies admitted no doubts, brooked no hesitation; and utterly contemning the charge of rashness, which cold unsympathizing minds are ever ready to bring against men whom they cannot understand, went straight to their quest, conscious of right, with a determined, unswerving purpose. They taught the world that valour was the better part of discretion, and the sequel proved that no foe could withstand their *rashness*, nor any hazard prove too formidable for their patriotism. Like a cold shadow, that word "rashness" has fallen on many a noble impulse, and darkened the road to fame. Judged by the common standard, it is a rash thing to take up a burning shell and to hurl it, at the point of explosion, away from the men who lie around it. A supreme and petrifying act of rashness, in this

sense, was that committed on the 6th of May, 1801, when Lord Cochrane, in the "Speedy," of fourteen 4-pounders (giving a total broadside of 28 lbs.), attacked the spanish frigate "El Gamo," armed with 32 heavy guns, and, after an hour's cannonade, had the temerity, out of all rule, to board and take her with 50 men against 320! The truth is (though I am not attemping to defend the converse), all great actions are open to this charge of rashness. Nothing great is lightly won, or wherein would lie its greatness? What is termed "the safe course" is so much the easier to follow, that it becomes ungenerous to the last degree to apply the common test of success or failure to a notable, daring, and independent course of action; yet an exception to these *ex post facto* judgments is rare. If a man succeeds in a perilous enterprise, the world calls it consummate daring, and proclaims him a hero; but if, whatever be his talents, he meets with unforeseen disaster, his misfortunes are aggravated by the specious charge of inconsiderate rashness, and ever after he is looked upon as little better than a madman. Very frequently emergencies arise, when the discreet precepts of a cautious policy are the most dangerous that can be followed, and when nothing but a bold disregard to mere prudential motives will serve to avert disaster or disgrace. In an energetic warfare great risks must be run, or great things cannot be accomplished. If a line-of-battle ship in a land attack is gallantly and successfully brought into action, with only a few inches water under her keel, all the world is open-mouthed in admiration. But if from the effect of an unseen shot-hole between wind and water, she were to ground, and things to take an ugly turn, what would be the verdict? Why, that her captain had paid the penalty of his headstrong rashness, and that such men ought not to be intrusted with command. Now this is as mischievous as it is unjust, for men, who would dare anything if assured of being impartially judged upon absolute premises, let slip golden opportunities while balancing between the chances of a doubtful success on the one hand, and of obliquy and censure on the other. Be then prepared for this contingency whenever in after-life you rise to a command. If untrammelled, your natural impulse will probably be the right one. Solicitude for one's

own interests is so apt to generate an undue amount of *caution*, that a leaning towards *rashness*, or a contempt of danger, which is its natural equipoise, is indeed little to be dreaded.

Look at Blake, Cromwell's sturdy envoy to the great European powers, who threatened the independence, and provoked the resentment of the young Commonwealth of England. Conspicuous for his godliness, he failed in nothing that he undertook. Though worsted by overwhelming numbers in his second action with Van Tromp, he in two months returned to the charge, and in a desperate engagement, which continued through three long days, gained a great and glorious victory, which broke for ever the dangerous supremacy of Holland.

The prelude to the bombardment of Porto Ferino, which he was compelled to undertake, in order to enforce the restitution of English captives, was a signal made for the performance of divine service in the fleet; and the result of this God-seeking was that in six months he made the name of Englishmen feared and respected from one end of the Mediterranean to the other.

"Our only comfort is that we have a God to lean upon, although we walk in darkness and see no light," is what he writes in an official letter to the Lord Protector, after describing the wretched condition of his squadron. And in his last letter written in England, addressed to Secretary Thurloe, and dated "aboard the 'Naseby' in St. Helen's Road, March 15th, 1656," after some allusions to certain sudden political transactions, there occurs this passage:—"But we know that God is the Supreme Disposer of all the councils, designs, and confederations in the world; and we know He is able to order them all for the greater good of His people; and our trust is that He will do so even for our good also, if we can believe in Him. The Lord help our unbelief, and subdue our hearts to the obedience of His holy will in all things." And so all things worked together for his good, and for the dear old land that sent him forth.

In the Yarmouth church books of 1652, there occur entries which afford an insight into the inner life of Puritan England, and indicate the source from which sprung all the glory and grandeur of her outer life. "This day was spent in seeking God," is an entry that frequently

occurs; and after Blake's temporary defeat by Van Tromp, "on the 7th of December they agreed that on the Thursday following, at ten of the clock, the church should meet to seek God for the navy at sea." How their prayers were answered, let the Dutch admiral, De Witt, tell. "Why," said he in the Assembly of the States, "why should I keep silence any longer? I am here before my sovereigns. I am free to speak;—and I must say that the English are at present masters both of us and of the seas." Thus the men of England prevailed, because they relied upon the Lord God of their fathers, and the eternal truth was manifested that "blessed is the nation whose God is the Lord."

Against the ports of Santa Crux, where lay moored in a double line the royal galleons of Spain, and against that spiritual despotism which claimed universal dominion over the bodies and souls of men, Blake, in one crowning action, finished the work which God had given him to do. On the morning of that eventful day, April 20, 1657, every man in the English fleet, kneeling down in humble prayer, committed themselves and their cause into God's keeping, in the deadly strife that was awaiting them. Undeterred by the terrific fire that opened upon his ships as they passed, Blake forced the entrance to the harbour, and in six hours silenced the batteries and either sunk or burnt every Spanish ship.

Slowly dying, Blake, after a last visit to Salee, to compel the Moorish corsairs to free their Christian captives, turned his head homewards, and at length arrived off Plymouth. Thousands were assembled to welcome the conqueror home; but ere the "St. George" had anchored in the Sound, he, in his silent cabin, in the midst of his lion-hearted comrades, had yielded up his soul to God. Precious should be his memory from whatever point we view it, and very serviceable it may also be, if we will only copy him in this, that Lord Clarendon tells us of him;—that "he despised those rules which had been long in practice, to keep his ships and men out of danger, which had been held in former times a point of great ability and circumspection, as if the principal art in the captain of a ship had been to be sure to come home safe again."

I have thus endeavoured to set before you, at the outset of your career, the examples most worthy of your imitation. To unite the spiritual with the actual is the great problem of life, and they who have acomplished it have performed that for which they were born into the world. The men you have read of solved this problem under circumstances similar to those in which we ourselves may be placed, and the record of their lives must consequently be to us of supreme importance. These remarks you will not therefore consider an inappropriate introduction, I trust, to the study of the work before you; for until you become ingrained with these principles, as your forefathers were, all the seamanship and science that experience and books can bestow will never make a seaman such as they were, of you or of any British lad. Remember then, that your life's vocation, deliberately chosen, is WAR—War, as I have said, as the means of peace: but still War; and in singleness of purpose, for England's fame, prepare for the time when the welfare and honour of the service may come to be in your keeping; that by your skill and valour when that time arrives, and "fortune comes your way," you may revive the spirit, and perpetuate the glory of days that tingle in our hearts, and fill our memories.

December, 1859.

SEAMANSHIP.

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PART I.

SECTION I.

NOTE.—*All Ships before being commissioned are fully rigged by the Dock-yard riggers; but, Is there not good reason to suppose that in a case of emergency, officers and crew may have to fit out their own ship?——To meet this it is selected as the first subject.*

FITTING OUT.

1. Your sheers are in the water alongside :—get them in, and raise them.
2. Get in, and step the lower masts and bowsprit.
3. Send a whole top over.
4. Send a half-top up.
5. Get a top off.
6. What are used for gantlines?
7. Only one gantline has been rove; if it unfortunately unreeves, leaving a man at the masthead :—how will you reeve it again?
8. Cut, and fit a gang of lower rigging.
9. Rig the foremast.
10. Set up the fore rigging.

11. Explain the use of battens.

12. What is the object of raking masts?

13. The mainmast of a ship 192 feet long is 64 feet from the deck to the trestle trees. How far abaft the mast will a line from the trestle trees plumb the deck, when the ship is trimmed two feet by the stern;—the mast having been stayed upright when the ship was on an even keel?

14. Your ship is in dock, and on an even keel; and you require to stay your mainmast so that, when she is brought down to her proper trim, say three feet by the stern, the mast may incline from the perpendicular half an inch to a foot. What rake will you therefore give it in the first instance, that such may be the result,—the length of the ship being 200 feet?

15 What is the use of the long batten on the fore side of the lower masts?

16. What are the small triangular pieces of wood nailed on either side of the hoops of a bowsprit; and why are there none outside the housing?

17 State the reason why the legs of the lower pendants are not of the same length, and which are the longest.

18. Which are the standing and which the spring stays (starb. or port) on lower and topmasts; which go on first; and on which side are the outer fore and foretopmast stays?

19. How are the standing parts of the lanyards of fore and main stays, and bobstays secured?

20. What is the reason that the mizen stays are smaller than the rigging (fore and main stays being the reverse)?

21. With the rigging properly turned in, cutter's-stay fashion, does the nip lie on the fore or after side of the shroud? and why?

22. When rigging is turned in with the end up, how does the end lie?

23. Give the lead of all the stays.

24. Of the three ways of turning in rigging, which is the strongest,—end up—dead-eye spliced in;—or cutter's stay?

25. In turning in rigging, after forming the knot of the throat seizeing, what is done with the end? and should the lie outside, or underneath?

26. How are the lanyards rove? and why?

27. In setting up lower rigging, how is the lanyard brought to the luff?

28. After the rigging is set up, are the rackings kept on or taken off? and why?

29. Having seen the effect of the different purchases, explain how their power is calculated.

30. Describe single and double Spanish burtons, and state the power gained by them.

31. In a tackle of two double blocks, where is the standing part? and why?

32. What size rope would you reeve as a three-fold purchase to raise a weight of 40 tons? and what weight will a rope bear, whose strength is equal to 8·9 tons, when rove as a three-fold purchase?

33. What is the comparative strength of wire with hemp rope?

34. If a schooner's main-stay, of 6-inch rope, to the foremast head, were at right angles to the mainmast, it would resist a strain equal to the full strength of the rope, or about 9 tons. What support would it give to the mast, if, when brought down to the deck, it formed with the mainmast an angle of 40°?

We will now proceed to rattle down. Small spars are lashed at equal distances across the rigging; the ratline-stuff of well-stretched 1¾ inch, is handed up:—

35. Give the distance for the ratlines apart.

36. State how they are seized on, and whether the clove hitch is inside or outside the shroud, with the reason.

37. On subsequently squaring ratlines, you find one about half an inch too long? you would not draw the splice, because that would make it considerably shorter; what will you do?

BOWSPRIT.

38. Gammon and rig it.

39. Which bobstay would you set up first? and why?

40. Then set up one.

41. Describe the fitting of a running in bowsprit?

LOWER YARDS, TOPMASTS, &c.

42. Get your main yard in from alongside the jetty.

43. If in the water.

44. Rig a main-yard.

45. Which is the upper side of a lower brace block?

46. What is the difference between lower and topsail brace block strops?

47. Through which sheeve in a lower-lift block should the hauling part reeve?

48. Being sent to the mast-house for your topmasts, you find that only one is ready :—not being marked, how do you know whether it is a fore or a main?

49. Why are additional heel-pieces nailed on a topmast and top-gallant-mast, instead of having a solid heel of the proper dimensions cut at once from the spar?

50. There is no shoulder for the cap on the fore side of lower and topmasts, and on the upper side of bowsprits :—what is the reason?

51. Describe the topmast and top gallant fids.

52. Main topmast on deck, get it on end ;—the lower mast having been got in by dockyard sheers, with the cap on.

53. Get a lower cap over, after the masts are stepped.

54. Get topmast crosstrees over, and send them down.

55. Rig fore topmast, and set up the rigging.

56. How are the sister-blocks seized into topmast rigging?

57. What objection is there to the usual lead of topsail lifts and reef-tackles; and how would you obviate it?

58. Rig a topsail yard.

59. Rig jib and flying-jib booms, whiskers, and dolphin-striker.

60. What are the advantages of a jib traveller.

61. Rig fore top-gallant and royal masts.

62. What is the reason that a top-gallant stay goes on before the rigging?

63. What are jacks and jack blocks?

64. Send the studding-sail booms aloft.

SAILS.

65. Draw the linings of a topsail.

66. Of a course.

67. Fit a topsail.

68. Fit a course.

69. How are the reef-points of fore-and-aft sails put in?

70. What is the difference between bowline and reef cringles?

71. What is the difference between the fore, main, fore-top, and main top-bowline bridles?

72. Is there any difference in the number of cringles in the leech of a fore and main topsail?

73. What is the difference between topsails and courses in the make of their clews?

74. How is the head-rope of a sail spliced into the leech?

75. How are the leech and foot ropes of a topsail spliced together?

76. How is a *sailmaker's*, or *rat-tail* splice formed, and when is it required?

77. Why have topsails a hollow leech?

78. Is there any roach in topsails and courses?

79. You see a square-sail marked on the head as follows—19½, 29, 12. What information is afforded you thereby?

80. A topsail becoming stretched, has too much hoist:—how will you reduce it?

81. What is the *principal* object in serving the foot of a topsail or course?

82. How many sized ropings are there in a jib, trysail, and topmast-studding-sail?

83. What are the different sizes of canvas; and what sail is each used for?

84. What is the breadth of canvas?

85. What is 18-inch canvas used for?

86. How are the seams of sails sewn?

87. What is herring-boning?

88. How are the eyelet holes in the foot of a topsail or course formed

89. What is the breadth of the seams of sails?

90. Are they the same width from head to foot?

91. Are all sails middle-seamed?

92. What are "sick seams"?

93. Having drawn at a foreign yard a topsail of a ship of a smaller rate, which requires an additional cloth in the spread, and having cut the sail up amidships for the insertion of the new cloth, state how you would add to the roping of the head and foot.

94. A similar sail requires a slight reduction in the foot. By cutting it, and bringing it together again with an ordinary long splice, too much will be taken up however careful you may be. What contrivance is there for meeting such a case?

REEVING ROPES; FITTING GEAR, &c.

95. What part of a ship's rigging is fitted by the dockyard?

96. How will you strop the lower blocks of the *yards*, *stays* and *up-and-downs*?

97. What is the best method of fitting a boom-sheet?

98. How do you reeve one rope by another?

99. You are going to reeve a new coil of rope. What do you do after cutting the stop?

100. What is the length of a coil of rope?

101. What is hawser-laid, and what cable-laid rope?

102. Wherein does three-stranded rope differ from four-stranded, besides in the number of strands?

103. What is a rumbowline?

104. Do you reeve the lacing of a jib or staysail with, or against the lay? and why?

105. Fit fore and main staysail stays.

106. Fit and reeve the gear attached to the different staysails.

107. Why are topsail-ties cut so much longer than is necessary for securing the standing part?

108. Do the topmast studding-sail halyards from the masthead to the jewel-block, lead before or abaft the top-sail yard? and why?

109. Do the jib sheets reeve inside, or outside the foretacks and bowlines?

110. How is the lacing rove, on the lower part of the luff of a spanker?

111. What is the advantage, and the disadvantage of the standing part of the peak halyards being secured to the topmast-head?

112. Is there any peculiarity in the make of lower tacks and sheets?

113. How should the sheets of all fore-and-aft sails lead?

114. Through which sheeve in the quarter block do you reeve the sheet?

115. Which is the swivel block of a top tackle?

116. Is a topsail-sheet secured with an inside or an outside clinch?

117. How are top-gallant and royal sheets secured?

118. Is the bill of the hook, in the standing part of fore and main sheets, up or down?

119. What is the advantage of main buntlines leading aft?

120. Reeve cat and fish falls.

121. What is a cat chain?

122. What sized hemp cables and hawsers have you on board?

123. What are the names of reef tackle and clewline, and fore tack blocks?

124. There are two kinds of toggles in general use: what are they called?

125. What is a gab-rope?

126. What is *hiding* a rope? and how is it done?

127. What is a spider hoop?

128. How are the reef-pendants of a boom-mainsail fitted?

129. What is a triatic stay?

130. What are the three most usual ways of building boats?

131. When does a buoy require *bleeding*? When is it said to *watch*; a cable said to *grow*; and a ship to *scw*; and what is stowing a cask "a-burton"?

132. How should the spare compass cards be stowed?

133. What is the principal disadvantage of wide chains?

134. What is the longest rope? and what are the three strongest pieces of rigging?

What are the two largest blocks supplied?

. Splice a three and four stranded rope together.

. Splice a hawser.

. In splicing a thimble into a large rope, after putting the ends in once and a-half, how do you finish it off ready for serving?

. In making large strops for general use, how do you splice them?

. The ends of the lower rigging require cutting;—how do you do it?

. What colour is the "Rogue's yarn" of the different dockyards?

. What do you suppose is the strength of a rope-yarn?

. A collar, of 8-inch rope, requires replacing, but you have nothing larger than 4½-inch on board. A double strop of the 4½-inch is therefore fitted, and considered equivalent to the single collar of 8-inch. Is it so?

. How do you ascertain the strength of a rope of a given size? and how do you calculate its weight?

. Which is the stronger,—hawser, or cable-laid rope?

. What is the object of rope being cable-laid?

. In round numbers, for practical purposes, state the proportion that hemp rope of a given size bears to its chain equivalent. For instance, if your topsail sheets of 5-inch rope were worn out, and you had nothing hempen to replace them with, would ½-in. chain be a sufficient substitute?

148. What is the strongest description of hemp rope?

149. You are in a ship without a ropemaker :—descril the gear employed, and show your men how to l up spunyarn, nettle-stuff, six-thread, hammock-las ings, and nippers; out of a piece of junk.

150. Is three or four stranded rope the stronger?

151. Does a splice weaken a rope?

152. What is a ropemaker's eye used for?

153. How is bunting supplied by the Dockyard, marked

154. What is the mark on canvas?

155. How is the Elliott's eye in a hemp cable made?

KNOTTING AND SPLICING.

156. Make a sheet bend.

157. A Carrick bend.

158. A Studding-sail bend.

159. A Rolling hitch.

160. A Timber hitch.

161. A Blackwall hitch.

162. A Clove hitch.

163. Hitch a ring-bolt over.

164. Make a common Marling hitch ; and show how would hitch the parts of a large strop over, such the double strop of a 30-inch purchase block.

165. How is the eye of your stream cable keckled?

166—169. Pass a round, throat, racking, and flat seizing.

170. Form a Shroud knot.

171. A Single wall.

172. Wall and crown

173. Double wall and crown.

174. A French Shroud knot.

175. A Matthew Walker.

176. A Turk's head on one end.

177. The same on a Jacob's ladder.

178. A Reef knot.

179. A Stopper knot.

180—182. A bowline, a running bowline, and a bowline on a bight.

183. A Flemish eye.

184. A fox, and Spanish fox.

185. Point, and graft a rope.

186. Point a 9-inch hawser.

187. What is cross pointing?

188. Show how hitching is done.

189. Pass a rose lashing.

190. Lay up a nettle, and thumb-line.

191. Whip a rope the several ways, and show what is a rough substitute for whipping.

192. Make a Grummet.

193. A Selvagee strop.

194. Common sennit.

195. French sennit.

196. Round sennit.

197. Square sennit.

198, A sword mat.

199. Splice a sword mat, and join two together lengthways.

200. Make a paunch mat, and show how it is repaired.

201. Draw and knot yarns.

202. Show how the two parts of a large strop are hove together before clapping on the seizing.

203. Worm, parcel, and serve? back the worming; and show how worming is hove on taut.

204. What is a marling-spike hitch?

205—210. Make a short, long, eye, cut, horse-shoe, and Grecian splice.

211. Splice a chain and hemp cable together.

212. Splice a deep-sea lead-line.

213. Make a cat's-paw.

214. A sheepshank.

215. Sling a cask with butt, and bale slings,—with a rope's end, and with the head knocked in.

216. Sling a wounded man for sending down from aloft.

217. Bend a couple of hawsers together.

218. Bend a hawser to the ring of an anchor.

219. In seizing two legs of a strop together, with an eye in each, you find great difficulty in passing a sufficient number of turns owing to the smallness of the eyes; though they will, at the same time take the requisite number of turns if you can only put the ends through. How will you do it?

220. Work a cringle into a rope or sail.

221. Show how to make a mat, and repair the same when cut.

222. How are boats' fenders usually made?

223. Form a clinch.

224. Make a set of hammock clews.

225. Grass sennit.

226. A Coir brush.

227. What do you understand by a 14-inch spar, a 10-inch block, a 6-inch rope, an inch chain, a 9-inch dead-eye, and a 12-hand mast?

BERTHING, STOWAGE, &c.

228. Berth your ships company.

229. Divide the men into messes.

230. What do you understand by the terms, wet and day provisions?

231. What tackle would you use for hoisting in provisions?

232. Your provisions are nearly expended, you are about to complete, what should be done with those left?

233. How, and where are the different provisions stowe

234. How will you ascertain the contents of a cask?

235. What are slops?

236. Give the size and capacity of the water tanks usu supplied.

237. Explain how tanks are stowed?

238. How do you start the water from a tank?

239. What is the weight of a pig of ballast?

READY FOR SEA.

240. You are ready for sea, hoist the steam launch in, give the words of command.

241. The same, ship rolling heavily.

242. State whether you top up, or brace up first, with reason.

243. Up rigging mats.

244. Weigh a bower anchor.

245. How is it secured for sea?

SECTION II.

AT SEA.

RULE OF THE ROAD.

146. What is the rule of the road, in the event of under sail only, meeting on opposite tacks?

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247. Is a ship on the port tack expected to give way to a ship ahead, which is standing towards her with the wind on the starboard quarter?

248. Two ships, each with the wind a point abaft the beam, are standing towards each other, and will inevitably come into collision if they continue their course. One is steering E. by S., and the other W. by S., with the wind at north;—what is the duty of each?

249. How should two steamers, meeting nearly end on, put their helms, to avoid collision?

250. How should a steamer act, when meeting a sailing vessel, to avoid collision?

251. What lights do vessels carry at night?

252. What measures are taken to prevent collisions during a fog?

253. Make all plain sail, on a wind, giving the orders.

254. Put the ship about.

255. Why do you let go the top-gallant bowlines when you raise tacks and sheets?

256. What would be the effect of shortening in the lee fore, like the lee main tack?

257. In light winds, with a head swell, what precautions would you take to ensure staying?

258. After hauling the main yard, you find the ship falling off again. (Port tack before going round.)

259. If, while in stays, you discovered, either just before or after hauling the main yard, that there was danger close upon (what would become) your lee beam, what would you do?

260. The wind freshens considerably; top-gallant sails and royals are taken in:—as officer of the watch, what precautionary directions will you give before hauling the head yards?

261. You observe, since the breeze freshened, that the ship has carried more weather helm;—what is the reason?

262. You want to haul the mainsail up while tacking, what difference does it make in the orders you give, in the evolution?

263. In a dead beat, what proportion does the whole distance run bear to the direct distance gained to windward in a good breeze with no leeway?

264. When the helm is put up or down, does the bow or stern alone move, or does the ship turn on her centre?

265. What is the reason, that when the sails first fill after stays, a ship heels more than after she has gathered way?

266. Wishing to fore-reach as much as possible in stays, what will you be particular about?

267. A vessel close to, renders it necessary that you should fore-reach as little as possible:—what will you do?

268. Working under steam and sail, go about with the watch.

269. Your ship is close-hauled on the port tack, with the wind at north; another ship on the same tack bears E. by N;—which is the weathermost

270. Your course is N.E. but you cannot lay it, and are heading N.W. on the starboard tack:—being taken aback, with the wind ahead, what will you do?

271. Wear under all plain sail.

272. Wear in as short a space as possible.

273. Wear ship in a strong gale.

274. It is absolutely necessary to wear a broken down steamer as she is drawing on shore, it is blowing so hard no canvas could stand for an instant, you endeavour to effect it with a couple of tarpaulins in the fore-rigging, but without success; can you think of any other expedient likely to succeed?

275. Wearing, blowing hard:—how do you shift the fore and main staysail sheets over?

276. Wear under staysails in a gale of wind.

277. Set studding-sails both sides, giving the words of command.

278. Take them in.

279. What is the first thing to be done after setting a top-mast studding sail?

280. What, after taking it in?

281. The ship is before the wind with studding-sails both sides, rolling heavily; you are unable to keep the lower booms out of the water (though they are

well topped up), and are thereby endangering the topmast studding-sail booms :—what would you recommend ?

282. In rigging out a fore-topmast studding-sail boom (setting studding-sails), owing to the quarter iron not being clamped, the heel flies up and the boom nearly slips through the outer iron ; you cannot rig it in by the boom-jigger, from the great weight of the outer part :—what will you do ?

283.—How is the heel lashing of a topmast and top-gallant studding-sail boom secured ?

284. What is the advantage of a studding-sail bend ?

285. How will you dip a top-mast studding-sail before all ?

286. In setting a weather topmast studding-sail, it gets before all :—what will you do ?

287. On the sail being set, *blowing fresh*, you find that there is a hitch with the down-haul round the outer clue ; you cannot take the sail in, for the down-haul will not render : how will you clear it ?

288. What do you use for the gear tricing-line forward ?

289. You are pitching uneasily in a heavy swell, the sails surging forward and aft with great force : wishing to set studding sails, what precautions will you take on sending the men aloft ?

290. Fore-topmast studding-sail set :—reef topsails.

291. You have made all plain sail again, and are going about ten or twelve knots, with the wind on the quarter :—haul up four points.

292. You are ordered to get the main-topsail sheets close home; which sheet will you clap the luff on first?

293. Would you haul taut the lee-boom sheet in a sea way to steady the spanker boom?

294. On setting the mizen top-gallant sail, the weather lift and brace come off.

295. Under all plain sail, the breeze increases gradually to a gale :—shorten sail by degrees!

296. Take the second reef in the topsails, giving the necessary orders.

297. While reefing, the weather reef tackle carries away and unreeves: what will you do?

298. Pass an Earing.

299. How are the third and fourth reef earings of a topsail fitted to the sail, and how are the first and second fitted to the yard

300. What is the first thing to be done after taking in a third reef?

301. Take in a close reef, on a wind.

302. Reef courses.

303. Blowing hard, take in a course.

304. Set a storm staysail.

305. Ship knocking about a great deal, send top-gallant masts on deck.

306. Under close-reefed main-topsail and reefed foresail, take in the latter.

307. Stowing a jib, blowing hard, what precautions are to be taken?

308. On a wind, the weather main-topsail brace goes.

309. The same,—wind on the quarter.

310. What do you use for preventer braces?

311. Blowing hard, the weather main-topsail sheet goes, and in clewing up, the clewline carries away.

312. Before the wind, parral of main-topsail yard carries away.

313. Parral goes on a wind.

314. You are officer of the watch, when a topmast stay carries away.

315. On a wind, under double-reefed topsails and top-gallant sails, a bobstay parts.

316. Under the same circumstances, jib-boom carries away, and is hanging at the bows.

317. Jib-sheet carries away, blowing fresh.

318. Main-tack goes, and in clewing up, the clew-garnet goes.

319. What is to be done on a tiller-rope carrying away?

320. A shroud of the lower rigging carries away, and not end enough for knotting and turning it in afresh.

321. Jib downhaul carries away.

322. In a strong breeze, ship rolling heavily, you *spring* your main-yard badly on the weather quarter: send it down and fish it.

Some time afterwards, the fore-yard *carries away*, in the same place; fish it, and send it up again.

Your rigging has become very slack:—being unable to set it up, what will you do?

. Lying-to, in a storm, the mainmast goes over the side, what will you do?

. What would you propose doing on discovering your bowsprit badly sprung on the under quarter, just outside the gammoning? the port you are working for being several weeks' sail ahead of you.

7. Running with a gale on the quarter, under close-reefed fore and main topsails and fore-staysail, you are brought by the lee.

8. Scudding in a gale under close-reefed main-topsail, reefed foresail, and fore-staysail: lay the ship to.

9. What is broaching to, to what is it usually owing, and what is the remedy?

10. Prepare for a hurricane.

11. You are thrown on your beam ends.

12. In a broken-down steamer, dismasted and quite unmanageable:—what will you do to keep the ship from foundering by the sea striking her astern or amidships.

13. The ship is much strained, leaky, and labouring heavily, with the water gaining on the pumps:—what should be done?

14. A friend of yours, Sub-Lieutenant one of Her Majesty's vessels, cruizing in the Mozambique, is put in

charge of a large slaver captured off Quilimane, and leaves for the Cape on the 12th February, 18—. A four days' run places her in lat. 27° S., long. 40° E., when the weather becomes unsettled, and an easterly swell is noticed. On the afternoon of the 16th, the wind chops round to the S.E., and the ship is brought to the wind on the port tack. The sun sets wild and fiery, hollow gusts come up and rapidly succeed each other as the day wears on, until 8 P.M., when the ship heels over to a steady freshening breeze from the southward, and a reef is taken in, in the topsails. Your friend goes below, and glancing at the barometer, sees no cause for apprehension in the not very extraordinary fall from 29·98 at noon, when it was last taken, to 29·70 in the subsequent eight hours. The wind continues much the same during the night, until 6 A.M. of the 17th, when it draws ahead a little, and at 10 A.M., having made about W.S.W. 80 miles, they tack. At 4 P.M., the breeze having freshened considerably, the topsails are double-reefed, the wind being S. by W.; and before 10 P.M., close reefs are taken in, courses and mizen-topsail furled, it then blowing a gale from the S.S.W. with a heavy cross sea. The barometer is referred to, and found to have fallen half-an-inch, (to 29·15); on which the fore-topsail is with difficulty taken in, and all made as snug as possible. At midnight, the wind is round to S.W., blowing a terrific gale, and the barometer rapidly

falling. Shortly afterwards, the main-topsail is blown to ribbons, and an attempt is made to lay her to, under tarpaulins in the main rigging, it being impossible to show any canvas to it. The wind by this time is round to W.S.W. About two hours afterwards, the main-topmast goes by the cap, and the mizen-mast a few feet above the deck; the fore-topmast is then cut away to save the foremast, the S. B. anchor cut adrift, and a whole cable veered to endeavour to keep her head to wind. The ship labours on, making a great deal of water, till near four in the morning, it then blowing a hurricane from the westward, when she is thrown on her beam ends, the sea making a clean breach over her, and but for a solitary survivor picked up on a spar, nothing more would have been known of the fate of the lost ship, but that which is contained in the mournful, but, alas! too common epitaph—"Foundered at sea!"

Point out the error committed, and state what you would have done, had you been placed in a similar position?

335. As a further illustration of this subject, we will suppose the following case:—

A vessel launched at Bombay, sails for England on the 1st of June, 18—, in charge of a lieutenant from the Commodore's ship, with the necessary subordinate officers, and forty men; and after a tedious passage down the coast, against a strong S.W. monsoon, arrives in lat.

6° N., long. 77° E., at noon on the 20th; the monsoo then blowing from the westward, and the course steere E.S.E.

During the day, they ran into a northerly breeze, an the course was altered to S.E., it being their intention t cross the line about the meridian of 86°. At 3 A.M., 21st the wind logged was N.N.E, 6, *q. u. r.*, bar. 29·90 (th barometer at midnight having stood at 30·01), the bri bowling along under port topmast studding-sails, whic they were reluctantly obliged to take in at 6 A.M. (bar 29·78). At 9 A.M., barometer had fallen to 29·64; and anticipating a gale, the mainsail was furled, top-gallant masts sent on deck, and three reefs taken in the topsails which they had reason to congratulate themselves o having done, for scarcely had they completed these pre cautionary measures at 11 A.M., when the gale *overtoo them*, as they considered, (bar. 29·38), and before noon sail was reduced to close-reefed main-topsail and reefe foresail, under which they hoped to run out of it, flattering themselves in the mean time that, while flying before th gale, they were making upon their course a good 14 knot an hour. (Bar. at noon, 29·00.)

By 1 P.M., the wind had drawn forward a point, (N.E. by N.), blowing a furious gale, and they were at last compelled to round to under the main-topsail and fore-stayail, getting their decks swept in the operation, and the pinnace stove in upon the booms; and, being unable to furl the foresail, the men were called down, and it was allowed to blow away. The log then is as follows:—

"2 P.M., blowing a storm (bar. 29·84), weather main-opsail sheet went, and the sail with it, on which the storm main-trysail was loosed and set. 3 P.M., wind N.E., blowing a most terrific hurricance, and ship in great danger; stationed hands for cutting away masts. About three-quarters of an hour afterwards, taken aback by a shift of wind; the vessel went over and lay with her yard-arms in the water, at which awful moment, Mr. ———, midshipman, and five seamen, were washed overboard. By great exertions, Lieut. ———, and several men, succeeded in securing themselves on the weather broadside, and in cutting away some of the weather rigging, when the masts and bowsprit went by the board, and Her Majesty's sloop righted with seven feet of water in the hold."

During the night she nearly foundered, and three more men were swept away while heaving the guns overboard, but by the morning, the weather having moderated considerably, and veered to the southward, they were enabled to set about rigging a jury-foremast, and a jigger-mast abaft; under which, having picked up the monsoon again, they arrived without further incident in Trincomalee harbour.

State how this danger and loss of life might have been averted, and what principles are illustrated thereby.

336. Two ships are drifting towards each other in a calm: they lower their boats, and endeavour to tow each other in contrary directions, but they still close:—what should they do?

337. How do you find the angle your yards brace up to?

338. What is the reason that the upper yards, on a wind, bear bracing in *nearer* than the lower ones?

339. The after-yards brace up sharper than the head-yards: —why then do they *touch* together?

340. Why is there more strain on the weather, than on the lee yard-arm?

341. The capability of a ship to work to windward results from her ability to make headway with the wind before the beam :—explain this property in a ship, and why, when the wind is forward, the ship is not driven astern.

342. You run into a ship and carry away your fore-chains, damaging the chain plates :—as you have no stores on board to build new chains, what will you do?

343. Get stern and quarter-boats inboard.

344. You are in hourly expectation of engaging a steamer of equal force with yourself, state what preparations you will make.

345. What do you consider the most advantageous way of engaging an enemy?

346. The chase is to windward :—when do you tack, and why?

347. If you stand on the same tack as the chase, till you can fetch her on the opposite tack, should she tack also, or stand on?

348. The chase is to leeward, on a steamer :—what course will you pursue, and what is her best chance of escape ?

349. How will you fight your ship ?

WITH A SQUADRON.

350. In "open" and "close orders," at what distances will you keep from your next ahead ?

351. What is the rule for the distance apart of columns ?

352. Explain what is meant by the term "Fleet Numbers ?"

353. What are "Columns of Divisions" and "Sub-divisions ?"

354. What is "Line Abreast ?"

355. "Quarter line," "Two Quarter" or "Two Bow Lines ?"

356. What is the "Direction of a Column ?"

357. On the Signal being made "Tack in Succession," when does the leading ship of the lee line put her helm down, and when do the other ships ?

358. What is a line of bearing ?

359. What precautions will you take as officers of the watch when wearing in line ?

360. Overtaken suddenly by a fog at night, what precautions would you think necessary ?

361. If the Admiral should, without a signal, or hoisting the disregard flag, commence any evolution :—what would you do ?

362. How do you ascertain the results of a trial of sailing?

363. A topsail-yard is sprung in the quarter, in a sailing trial.

364. Your main-topsail splits right across the head.

365. The leech of a topsail is carried away in a fresh breeze you might deem it advisable to repair it:—how would you effect it?

366. Main-stays carried away.

367. Rudder disabled.

368. What are the rudder-chains for?

369. How is a rigging-stopper fitted, and how put on?

370. Away in a prize, your binnacle is washed away; with no spare compass on board, what will you steer the ship by?

371. The necklace on foremast head carries away; you cannot stand long on the opposite tack if you go round, so secure the topmast as soon as possible.

372. Take in a brigs boom-mainsail in a squall.

373. How is a boom-mainsail stowed?

374. In a small vessel close hauled, the wind shifts aft:—will you trim the head or after yards first?

375. In your own ship again, reef topsails in stays.

376. "Man overboard!"

(a) All plain sail set, on a wind; and state whether you haul the mainsail up before or after squaring the main-yard?

(b) Plain sail, before the wind.

(c) Studding-sails one side.

(d) Studding-sails both sides.

377. The man is picked up, apparently lifeless:—what steps will you take to restore animation?

378. On which side is the trigger for firing, and which for letting go the life-buoy?

379. A topmast is shattered by lightning, you are afraid to start the rigging without taking some precautions:—how will you send it down?

380. A topsail is on fire by lightning.

381. How is a topsail made up for bending?

382. A course?

383. A jib?

385. Shift mainsail.

386. Shift jib.

387. How would you tell the head of the jib from the tack in the dark?

388. Shift jib-boom.

389. A top-gallant mast.

390. A topsail-yard.

391. Running in a gale, you spring your main-top-sail-yard: replace it.

392. What do you do with a sail tackle after using it?

393. The upper block of the sail tackle comes out of the strop, the sail having been swayed up thirty feet from the deck :—what order will you give ?

394. How is a spanker made up ?

395. A topmast studding-sail, for setting ?

396. A lower studding-sail ?

397. How are your topsails and courses stowed away?

398. Is the standing or hauling part of a top-gallant mast rope rove through the lizard, and why ?

399. To which bolt in the cap is the standing part secured?

400. Under top-gallant sails, the main top-gallant-mast carries away, and falls before the topsail :—how will you send the wreck down ?

401. When stowing a jib in cloth, what part of the sail forms the skin and explain the stowage of this sail.

402. Mark a lead-line.

403. Mark a deep-sea lead-line, and get a cast.

404. What is the best way of taking very deep soundings from a steamer ?

405. Mark a log-line.

406. You are officer of the watch ; the ship is under top-sails and courses, and you see a very heavy squall coming down to windward, the sea white with foam :—what will you do ?

407. Taken unprepared, what is your first order ?

408. Set the fore-topmast studding-sail, blowing hard.

. Take it in.

. One vessel in tow of another; the headmost one puts her helm down to go round :—how does the other proceed?

. Prepare to be taken in tow by a steamer, and announce when yon are ready.

. Prepare your ship, for rounding the Horn in the winter months.

. What is club-hauling and how is it effected?

. On a wind, you run ashore.

. At a quarter ebb, you get on shore, where the rise and fall is very great, and so rapid, that the water lessens quicker than you can lighten the ship :—what will you do?

. You are taking your ship up a river, and are forced by an ebb tide on a reef of rocks. All attempts to get spars over, as shores, are rendered futile by the rapidity of the current, and, in defiance of all efforts to the contrary, the ship falls over 22°. The usual preparations are made by battening down the hatchways; but, owing to a defect in the pumps, the water gains upon the ship, and she falls over and remains at an angle of 45° :—how will you endeavour to raise her?

. Under double-reefed topsails, courses, top-gallant sails, and fore-topmast staysail, you spread a surface of 4,800 yards of canvas, and are going in

a fresh breeze 8 knots on a wind; but anxious to get on, you are tempted, though at considerable hazard to the spars, to make sail to whole topsails, jib, and spanker, which gives an increase of 1,600 yards, or *one-third* more canvas than at first:—under these circumstances, what will be the increased rate of speed?

418. Raise a screw propeller.

419. You are making a passage under sail, and find the drag of the screw retards your speed very much; and it cannot be raised what will you do to lessen its dragging?

420. What effect does backing astern, have on the ship's head, if there is any wind?

421. State what advantages and disadvantages twin screws possess, when compared with a sinlge screw?

422. You are coming in from a long cruize, and wish to make a good figure in the squadron; you are to make a running moor,—bring your ship to, and state what you would do that she might look well a few hours after anchoring.

423. A prize is captured off a foreign port, and you are sent in to refit and provision her, preparatory to putting to sea again in three weeks' time. Finding that her three chronometers have been allowed to run down, and that there is no other ship in harbour with whose chronometer of known rate

you can compare your own :—state how you would rate them by observation, and how you would avail yourself of the results in the ensuing voyage.

SECTION III.

ON GENERAL SERVICE.

In a storm on a lee shore you are riding in a sailing vessel with four anchors ahead, from which you are beginning to drive :—what will you immediately do?

. Having parted from all your anchors, are your resources, therefore, exhausted?

. In the port that you are bound for, heavy gales from the N.W. are prevalent, and you are consequently recommended in the local Sailing Directions to moor with open hawse in that direction. How will you lay your anchors out, and with what cable will you moor in 10 fathoms water?

. Anchor in fine weather with a spring on.

. What will you look out for on coming to with a weather-tide?

. When coming to, at the order "Stand clear of the B.B. (or S. B.) cable," what takes place?

. Name the parts of an anchor.

431. You are in charge of a prize, a sailing vessel, explain how you will get her up or down a river too narrow to admit of her tacking.

432. Rig a nun-boy.

433. Bitt a hemp and a chain cable.

434. Pass a nipper.

435. Heaving in you drag through all.

436. Describe a deck tackle, and state how it is used.

437. How is the cable, BROUGHT TO, with a patent capstan?

438. How many swivels are there in a cable?

439. What is the length between the shackles of chain cables, and how are they marked?

440. What are the uses of the stay-pin in the links of a chain cable?

441. What is a ganger

442. What advantage have hemp over chain cables?

443. How are the hemp cables coiled away, and how are the ends secured?

444. How do you stopper a hemp cable?

445. Pass a hemp messenger.

446. After heaving taut and unbitting, what do you do before heaving round?

447. When and how are hemp cables stoppered when coiled away below?

448. Prepare a hemp cable for coming to with.

Which end of a chain cable is shackled to the anchor?

After putting the slip on, what is done with the cable, before surging?

Describe and put on a swivel.

Take it off.

Ought the cup of the swivel to be kept up or down?

You are ordered to Spithead for the winter, and intend to moor with a swivel on, in 11 fathoms water with four shackles on each cable; you therefore, on coming to, run eight shackles taut out on the first anchor, let go the second, veer away, and heave in on the first:—do you by these means ensure mooring as you wish?

You are slackly moored, with a swivel on, and are required to take it off, both cables being up and down:—how do you tell the starboard from the port cable, to avoid shackling the wrong cables together?

When a ship is moored with an equal strain on both cables, are the two cables, under any circumstances, weaker than a single one ahead would be?

How do you keep your hawse clear in a tide-way?

Clear hawse.

At single anchor in a tide-way, what means will you take to keep a clear anchor

Being officer of the watch, you are ordered to see all clear for letting go a sheet-anchor at a moment's notice:—do so.

461. Veer cable, blowing a gale.

462. Why do you veer cable in heavy weather?

463. Messenger carries away.

464. The anchor is at the bows with the stock gone:—stock it afresh.

465. It comes up to the bows flukes uppermost.

466. How are the cat and fish hooked

467. The cat-block is found defective: what will you replace it with?

468. You want to let go the anchor again, having just hove it up to the bows:—what is to be done before letting go?

469. Having slipped your cable, return and pick the anchor up again, the buoy having sunk during your absence.

470. You foul another ship as you are getting under weigh, and carry away your boomkin and cat-head flush with the bows:—how will you secure the anchor for sea, and work the foresail?

471. Having hove a sheet anchor up to the bows, get it into its place.

472. Having lost an anchor, take a waist anchor for the bower, and cat and fish it.

473. You have lost all your anchors but one, and that has but one arm:—on coming into an anchorage, how will you let it go to ensure its taking the ground

Weigh, under sail, in a fresh breeze, making as little stern-way as possible, as there is a ship in your wake, but without laying a kedge out.

Lying at anchor close to and parallel with the shore, with a heavy swell setting in on port bow, and no room to cast to starboard:—get under weigh, under sail, and ensure casting to port.

How will you pick up your anchor in a strong weather tide, but with a breeze so fresh that the ship is forced taut ahead of her anchor?

You are anchored close to a long line of ships on your port beam, with a shoal astern of the leeward-most ship, running at right angles to the line:—weigh under canvas.

In weighing, under sail, what is the proper moment for tripping the anchor?

You are lying close to a lee shore in a sailing vessel, it is blowing too heavily to warp off, and you are too near the shore to weigh and make sail in the usual manner:—how will you leave the anchorage?

Back an anchor.

How will you make a kedge which is rather small more effective?

Lay a bower anchor out by the launch under ordinary circumstances.

In a ship without a launch, lay out a sheet anchor, which it is necessary to back with the stream, for heaving the ship off shore in half a gale of wind.

484. Having no available boats, calculate the number of water-casks (butts) requisite to carry out a 95-cwt. anchor.

485. In the event of your not knowing the capacity of the casks to be employed, how would you ascertain it?

486. What number of 4-feet tanks, weighing 7 cwt. each, would you take to perform the same operation? (Internal capacity not given.)

487. What spare spars would you select, in default of other means, for laying out the anchor; and what weight would such spars sustain when used as a raft?

488. Send a stream anchor and cable to a ship's assistance.

489. Seeing, from the way a ship is coming in, that there is a strong probability of her fouling you:—what preparations will you make for the event?

490. As midshipman of a boat, you are sent away with orders to anchor off a certain place, and on arriving there, you find a rocky, irregular bottom; there being great probability of the anchor becoming jambed among the rocks:—what will you do to ensure getting it up again?

491. Sent away in charge of a seining party of raw hands, show them how to shoot it.

492. Your boat stows 14 butts and 12 puncheons:—what quantity of water does she carry in tuns and in gallons?

3. In warping your ship out of harbour, it has been necessary to coil a hawser away on deck as it was run in; and, on a boat coming alongside to receive it again, the end has been taken in the hurry through one of the bights; consequently, on coiling it in the boat, an overhand knot is found in the hawser, when about half coiled away:—how will you clear it?

4. What is the usual plan of watering ship, by means of launches?

5. Get your boat ready for bringing off water in a bulk.

6. How will you get your water through a heavy surf?

7. How will you fit the rain-awnings to your boats?

8. You see a boat standing for the ship in very bad weather; it is as much as she will do to fetch—if she misses she will be driven to seaward, as she cannot make headway under oars against the sea:—what will you do?

9. In command of boats you have been employed towing a ship out of harbour; but, before you part company, a thick fog comes on:—how will you find your way back, having no compass?

500. Ordered to shove off and set fire to an enemy's vessel or buildings, what will you take with you?

501. In a boat out of sight of your ship, and to leeward of any anchorage, a gale of wind and heavy sea springs up:—what will you do for the safety of the

boat, as she is beginning to take water in faster than you can bale it out?

502. On the following day the weather moderates; you pull till nightfall without sighting land; you have no fresh water in the boat, and you are parched with thirst:—what expedient will you resort to for relief?

503. In a heavy surf, land and get off.

504. You are pulling along shore, but, owing to an adverse wind and tide, are not making headway, and it is useless to attempt to beat up:—to what expedient will you resort?

505. You are caught in a squall in charge of a ship's cutter.

506. Having been away in your boat, and had occasion to load your rifles, what will you be particular to do before returning on board?

507. Bullocks are brought off, hoist them in.

508. Hoist in a restive horse.

509. You have a water cask on deck which you wish to up-end:—how will you set about it? Its weight would be about half-a-ton.

510. In what length is condemned rope returned into store?

511. A 64-pounder gun, is on shore dismounted, it would render important service could it be brought into play; you are therefore sent to see what can be done. A party of men are sent after you, but they are unable to bring anything with them that could

assist in raising it. Not a spar is to be had anywhere, and all you possess, besides the carriage with its sea-service equipment, is the ammunition and usual stores:—with these means are you sufficient to mount and fight her?

It is subsequently required on the summit of a precipitous hill; you have lately received along with some casks of provisions, two good hawsers:—how will you transport it?

How will you stow a couple of similar guns in your launch, having to take them ashore, and land them on a beach?

. Having rigged a triangle ashore, explain the way you would mount them.

. What are the two ways of working a parbuckle, in transporting dismounted guns for instance?

. Having a gun ashore without a carriage, how will you fight her?

. Place a field-piece and limber in one of the boom-boats and land it for the purpose of exercise.

. Land a boat's gun as a field-gun, in the face of an enemy.

. Describe the purchases you would use to hoist in an 8-inch rifled gun, weighing nine tons; also how lighter guns are usually got in?

. In 1857, a brass gun was captured in one of the forts in the Canton river, which measured from base-ring to muzzle 19 ft. 10 in. Its circumference between

base and trunnions (a distance of 8 ft. 6 in.), 7 ft. 1½ in., uniform throughout, but from trunnions its circumference decreased to 5 ft. 2 at the muzzle. The metal in the rear of the b ring, moulded in the form of rings terminating button, weighed about 5 cwt., and its bore 9 in. :—what was its weight?

521. What would be the weight of her shot, of 8·7 inc in diameter?

522. You discover your mainmast to be decayed, dis of the old one, and get a new one in, having spars on board suitable for sheers, and b unable to procure any.

523. Get your main yard fore and aft in harbour.

524. Give the words of command for "unbending sail

525. Get the bowsprit cap off and on.

526. Shift bowsprit with your own means.

527. Will your own spars form sheers capable of ge out a lower mast?

528. Hoist a paddle sloop's pinnace out.

529. Hoist in a long spar.

530. Hog ship.

531. As mate of the upper deck, state your ideas o subject of hammocks?

532. See all ready for dressing ship.

533. With what ceremonies do you celebrate Her Maj

birthday ; and what is the etiquette on arriving in a foreign port where an Admiral's flag is flying ?

Hoist in a gun or mortar, weighing 30 tons. Calculate the strain on the gear employed—the centre of the main hatchway down which it is to be lowered being 15 feet before the mainmast, the hold of the lighter in which it is to be brought off, 10 feet from the ship's side, and the beam of the upper deck, say 50 feet.

. It is your object to enter a French port, of which you have only a French chart, which states that *les sondes sont exprimées en mètres*, and *la mer marne d'un mètre environ ;* your ship draws 19 feet and the shoalest part of the channel is marked 6 ; supposing, then, that to be the actual depth of water at the time, is it sufficient for you ? state also whether you would be able to make use of a Russian, Dutch, Danish, or Spanish chart in the original.

5. Before sailing in charge of an iron steamer, a prize, swing ship to ascertain local attraction.

7. You take a prize upon the stocks,—a ship of 800 tons, nearly completed. No spars have been prepared for her, but as there are plenty at hand of various dimensions, it is decided that she shall be launched and got ready for sea. You are given command of her, and directed to furnish a scale of masts and yards suitable for a ship of her size, and to ascertain the position the masts should occupy.

Her length on the upper deck, is 152 feet, and extreme beam 35 feet.

Data are also required for masting cutters, schooners, and boats of various rigs.

538. Explain the operation of heaving down.

539. How would you sling a sunken vessel, for the purpose of raising her?

540. How do you ascertain a ship's tonnage?

541. How are your booms stowed?

542. On a fire breaking out on shore, you are sent in charge of a party to aid in extinguishing it:—what will you take with you, and what course will you pursue on landing?

543. How is a rudder attached to the sternpost, and kept from unshipping?

544. What is a balanced rudder, and what are its advantages and disadvantages?

545. Explain the action of the rudder of a screw ship with regard to speed, and a large or small angle of rudder.

546. What causes weather helm?

547. Having sprung your rudder, send it ashore and replace it with a new one.

548. How will you construct a temporary rudder from the ship's stores?

549. What is the object of a false keel?

550. How will you permanently guard yourself, in an

enemy's river, against the approach of fire-vessels, torpedo-boats, and explosive machines?

Engaged in operations against the enemy, you meet in your boats with a boom and chain, which it is necessary to force:—what is the readiest method?

Moor head and stern, in a ship with no appliances for securing stern-chains.

How will you replace a sheet of copper on a ship's bottom, several feet below water, without docking, heaving her down, or having the aid of a diving apparatus?

On a foreign station, it becomes necessary to dock your ship. The dock not being adapted for the reception of ships of large draught, you clear the ship, and get the masts out. By so doing, she is lightened sufficiently forward, but still draws considerably too much water abaft:—how would you propose to lift her stern over the sole of the dock?

In a ship's pinnace, manned and armed, towing astern of a steamer going at full speed, with a sea getting up:—take the necessary precautions for the safety of your boat.

Your mizen-mast is discovered to be very unsound from dry-rot; and in your rambles ashore, in a country but little known, you come upon some tall, branchless trees of hard wood whose height, therefore, you are desirous of obtaining:—how will you

ascertain it without any appliances but such simple ones as will always be found on the spot?

557. How do you ascertain distance by sound?

558. Your hawse-pipes on each side are broken and cut down by the cables, which you are obliged to work in the spare hawse-holes :—how will you repair the injury?

559. Which rides the easier, a light ship or a deep one?

560. Which end of a spar would you tow foremost, the bluff end, or the small one; and whereabouts in your boat will you make the tow-line fast?

561. Describe the system of making Flashing Signals?

562. As signal midshipman of the flagship, find the time for making it daylight and sunset at a given place and day, say at Hong Kong, May 1st, 1856.

EXPLANATIONS.

EXPLANATIONS.

PART I.

FITTING OUT.

IGGING SHEERS.—The sheers having been towed
le, with their heads aft, take two stout hawsers,
them, pass the bights over the ends of the spar,
cure the underneath ends inboard, the hammock
g having been previously removed. Reeve the
parts of the hawsers through leading-blocks on the
e side of the deck. Hang small spars from the
to keep the sheers clear in coming in. Man the
;—tackles having been clapped on if necessary;
de the spar up to the upper works, and take a turn
e hawsers. Secure three or four small spars in a
; direction, inboard from the upper works, to ease
ers down on, and pass the bight of a small hawser
e main-deck ports over each end of the spar for
ıe purpose, making one end fast and taking a turn
ıe other; then haul away on the parbuckle, and
way on the main-deck hawsers till the spar is
Proceed with the other in the same manner.

However, instead of parbuckle, I should, in preference, get sheers in over the stern, by rigging small sheers over the taffrail, and by them lifting the end of the spar up to the stern port on the upper deck; then clap on a tackle led along the deck, and rouse it in. By clearing away the head berthing, they may also be advantageously got in forward; in which case, the lighter end of the sheers would come first.

When in, rig a small pair of sheers; with them raise the sheer-heads on the poop, cross them by placing the sheer-head of the side on which the mast is coming in uppermost, and lash them with a round lashing of 4 in., passed on the bight with six or seven turns *on each end*, then back again with riding turns,—making 23 or 27 turns in all, and knot.

Protect the sheer-head lashing carefully with old canvas where the purchase-strop takes, and take a four-fold block, double stropped, for the upper block of the main purchase; place the bight of the starboard end over the starboard sheer-head, and the bight of the port end over the port sheer-head, then reeve the ends contrary ways through the bights of the strop, pass bight and bight as before, and knot the ends when the lashing is expended.

The upper block of the small purchase (an upper jeer-block), is placed on the underneath, or after part of the sheers, lashed as the other, but hanging below it, the bights lying on the fore side, and across the turns of the main purchase strop.

Then lash the topping-lift, for which the fish-tackle will do.

'or sheer-head guys, which are placed next, take the
e 9-in. and a 7½-in. hawser, which reeve through four
blocks lashed at the sheer-heads, those for the fore-
s being uppermost.

'or the belly-guys, on the fore and after side of each
r leg, use the fore and main runners and tackles, and
e sheer-head gantlines.

Leeve the purchase, using a three-fold purchase-block,
another upper jeer-block for the lower blocks, overhaul
fore-guys and main purchase forward, the former to
cat-heads, and the latter toggled through the hole for
bowsprit. Open the sheers out, place the shoe, lash the
ls securely, but slackly, to a fish-davit, or other spar,
l outside the nearest port abaft the heels, and shore all
ks well up underneath. Hook up-and-downs forward
l aft on each side, as heel-tackles. Bring the purchase
the capstan, man well the fore-guys, and attend the
r-guys and heel-tackles. Raise the heads by the
all sheers, heaving round and hauling on the purchase;
ig the small sheers when they are of no further use,
d heave away. When on end, hook a couple of luffs
m one heel to the other, which bowse well taut and
p; transport the sheers aft to the break of the poop,—
tting the deck, and keeping the heels in advance, lash
e heels taut between the ports, over cleats on the
eer-legs, looking out that they are stepped over a beam,
wse taut the heel-tackles, set all the guys well up (the
eer-head guys with luffs), and come up the purchase
rward.

2. GETTING IN LOWER-MASTS AND BOWSPRIT.—The masts should have the gant-line-blocks and strops for the purchases to toggle to, lashed before launching. The height of the sheers, the length of the mast, and the depth of the housing, must regulate the position of the strops; but supposing the sheers are as taunt as you desire, have the strop for the main purchase just above the upper-deck partners, the strop for the small purchase above the centre of the mast, and the topping-lift at the mast-head. Canvas must be placed round the mast under the lashings, and cleats nailed above to prevent them slipping.

The mizen-mast being alongside, with the head aft, overhaul the small purchase down, and hook the topping-lift to a strop below the trestle-trees. Lead the fall down the after hatchway, through a leading-block, and bring it to the capstan. Sway away, and when up to the main-deck ports, pass a couple of hawsers out, which bend to the head and heel, ready to ease away as you sway inboard. Reeve the mast-head gantlines, clap a tackle on the heel to bowse it over the mast-hole, pull up on the topping-lift and point the mast, walk back, heave it on the right slue, and lower it into the step; drive four or five wedges in, and come up the purchase.

Transport the sheers before the main partners, and get the mainmast in, in the same manner. Lead the main purchase down the main hatchway, through a leading-block, and bring it to the main capstan; and the small purchase, with the same lead, bring to the fore capstan. The topping-lift work on deck.

Having similarly got the foremast in, keep fast the belly-
s to steady the sheers, unreeve the fore sheer-head
s, and shift the blocks to the hounds of the fore-
st. Come up the after sheer-head guys, and secure
e part of each to the foremast-head close down, and
ve the other ends through the blocks, and so down on
k, thus converting them into sheer-head topping-lifts.

Haul down on the purchase, ease away the topping-lifts
l droop the sheers; then the belly-guys being of no
her use, take them off, and shift the fore runners and
ckles to the after part of the foremast-head, lashing the
cks where the standing parts of the topping-lifts are
ired, then take them aft, and set them up for the
port of the mast.

As for the mizen-mast, the small purchase and topping-
the latter, slued round, will bring the bowsprit in,
ich should be slung midway between the housing and
centre. Send the purchase down abaft the boomkin,
, if before, you would jamb the bowsprit between it and
: cutwater, and be thereby prevented from swaying it
her; toggle on, hook the masting topping-lift to a strop
ough the cap, where also hitch a couple of guys rove
ough blocks at the cat-heads. Sway away, topping on
: cap purchase when necessary; when clear of the
omkin, drop the sheers to the required angle, and sway
ay; point the heel, ease up the main purchase, and, if
: partners are well greased, the mast will come down
o its place as you pull up on the cap purchase, without
: aid of bedding-tackles.

The heels of the sheers are then fleeted aft, the sheers lowered down by the topping-lifts, unrigged, and hoisted out.

3. GETTING WHOLE TOPS OVER.—Up-end the top on its after-edge, abaft the mast, underneath side of the top, forward. Lash the gantline blocks on each side of the mast-head, as close up as possible, frapping them over the head of the mast to keep them well up. Take the after end of each gantline under the top, up through the after (or next to after) futtock hole, down through lubbers' hole; and after this, reeving up through the foremost futtock hole; hitch the end of each gantline to its own part at lubbers' hole. Then get a guy from aft, bend it to the after part of the top, and stop it with the two gantlines already bent to the holes in the fore part of the top. Steady taut the after guy, sway away the gantlines, keep the top clear of the trestle trees with the after guy; when close up cut the stops, sway the top over, ease it down, place it, cast off the gantlines, get up the sleepers, and bolt the top down to the crosstrees. A mizen-top is nearly always sent up before the mast, that you may have the assistance of a gantline from the mainmast; if this is done, place the top before the mast, as it would lie when over; bend the mizen gantlines to the foremost futtock holes, and the main gantline to the fore part of the top: stop all three gantlines to the after part of the top, and sway as before.

4. GET HALF-TOPS OVER.—Place the half-tops on the deck each side of the mast, as if in their place; lash two planks across the trestle-trees, with a bolt lashed on the

p of each, exactly between the trestle-trees. Take the ter end of the gantlines abaft all, each on its own side; nd to the half-tops with a round-turn as near the centre possible, and hitch each to its own part; stop the bight the futtock hole abreast the hitch; bend a gantline om abaft to the after part of the half-top, to keep it clear it goes up; sway until above the crosstrees, rest the idship parts on the planks against the bolts, lower the gant-ıe, remove the planks, place the sleepers and bolt down.

5. SENDING TOPS DOWN.—Bend each gantline with a und turn through lubbers' hole and one of the futtock ıles, so slinging the top that the after part will be slightly avier; bend a gantline or guy to the fore-part of the p, from abaft, to bring the top aft when swayed off; ıbolt and send down the sleepers, bend a rope's end om the deck to the fore-part of the top, to keep it square hile swaying. When this has been done, sway till the re-part clears the mast-head, haul on the after gantlines, uy clear of the trestle trees; unbend the rope's end and ower away.

Half-Tops.—Commencing with port half.—Bend the port gantline round the half-top at fore part of lubbers' hole, and stop it to the fore part of the top. Bend a fore and aft gantline to the after part of the top; sway the upper gantline, haul on the fore and aft gantline, and when clear of the trestle trees, lower away, and proceed in the same manner with the other half.

6. GANTLINES.—For the fore and mainmast, the top

tackle-falls are drawn; peak and throat halyards fo mizen-mast.

7. GANTLINE UNROVE.—Direct the man at the head to draw the splice of the block-strop, unla strands and knot the yarns, then send them dow hauling-line.*

8. CUTTING OUT RIGGING.—Hemp rigging i almost unknown in Her Majesty's Service; but question of how it was fitted, may still be asked, thought it as well to insert the answer. Meas distance with spunyarn, from the bolster on one the mast, to the foremost dead-eye in the chains other; or take the length of the mast from the we the bolsters, as one side of a right-angled triangle, distance from the centre of the mast-hole to the c the foremost lower dead-eye as the other, find th side?

* This is a standard *catch question*, and is inserted as a spe the nautical enigma known as such. Many midshipmen labo the delusion that elaborate improbabilities of this description staple of the final examination for lieutenant. I have heard under whom I served some years ago, gravely accused of t midshipman back for not knowing how to *stow a hold in a gale* And there is a tradition afloat of an unfortunate candidat *missed stays*, in consequence of being puzzled how to get anchor out, which was lying inboard;—there being no masts in the ship wherewith to raise it. Considerable erudition displayed in discussing this question; and I believe that i dilemma the correct thing is to hoist it out with a derrick of its own stock!

is distance place two posts: take the shroud hawser its end at either post, warp round and round both, ach turn carefully outside the other, one complete each pair of shrouds, and half-a-turn for the pen-

once-and-a-quarter round the mast above the , and half this distance measured from the crown hrouds, will be the point for commencing the first each serving, which mark with chalk, cut through tre of the bights at the end you commenced warp- d on the crown of the other bights, marked notted spunyarn, the number of the shroud, ncing with one knot on the inside bight for the of distinguishing them. Run a chalk mark across er bights, distant from the post a third of the from the deck to the bolsters, which, when you fit ing will mark the termination of the service.

each length on the stretch separately, ready for New rope before fitting should be stretched one the foot.

n, parcel, and serve the eyes of each pair of shrouds halk mark, but continue the foremost shroud on le, the whole way down. Parcel the shrouds in e of the serving, to keep it from sinking between s of the service.

rigging should not be warped off, but the length oremost and after shrouds having been measured foremost and after dead-eyes, in the chains to

the bolster on the opposite side; divide the difference in length between the intermediate shrouds, adding the diameter of the rope to each pair in succession.

A wire shroud is completely served over; the pendants are fitted with an eye of the same size, and in the same manner as the shrouds; one leg being one-third longer than the other, with thimbles spliced into each end.

If it is necessary to have an odd number of shrouds, it will be found a good plan instead of connecting them with a horse-shoe splice, to fit an eye splice in each, and put them on first.

Measure the drift for the stays, and form a collar the length of the masthead, by splicing a fork into the upper end. Form a Flemish eye at each end of the fork, and worm, parcel, and serve, a fathom below the crutch.

In parcelling rigging, the canvas should always be worked up, to prevent water getting between the parts of the parcelling.

9. RIG THE FOREMAST.—Get up, lash, and steady taut the runners and tackles, the uppermost just under the necklace, and the lowermost two-thirds up from the deck. Shift the two mast-head gantlines down to the after cross-tree on each side of the mast, and lash a block on the after side of the mast-head for a short gantline, to reach into, and be worked in the top.

A shroud is sent over, by seizing both parts of a pair together about a quarter down, the gantline bent to a toggle and slipped under the seizing, a rope's end being

lso bent to it to round down again. The gantline is topped to the shroud below the eye-seizing, and at the rown of the eye, which is kept open with a piece of punyarn from the crown to the seizing. Sway away, and hen it comes up to the top, bend on the short gantline nder the seizing, stop it up to the crown, on the upper ide of the shroud, cut the stops of the long gantline, and way over the mast-head. A short gantline is used, to void the trouble of hauling up and dipping the long antline as you sway each pair of shrouds over, which ould be the case were they kept at the mast-head.

Then, first tarring and parcelling the bolsters, place the igging as follows:—starboard and port pendants, starboard nd port pair of shrouds, and so on; beat each shroud ell down with commanders; then the after shroud on ach side, fitted with an eye splice or horse-shoe. After ach pair of pendants and shrouds are roused down separately into their places with up-and-downs on each side, and a luff on each shroud of a pair (both brought to the up-and-downs), the fore stays are sent up by the gantlines, and lashed with a rose lashing abaft the mast.* Then lying close down on the stays, having been passed up between the collars, the jeer-block strop is lashed abaft the mast. Over all, close down to the trestle-trees, is the strop for the fore stay tackle or tackles, fitted with one or two thimbles, as the case may be, and hanging down

* The collars of lower stays are sometimes taken over the cross-trees and cleated down on the mast-head, to allow the yards to brace up the sharper.

abaft the mast-head. If a chain strop is used instead it should be placed on the bolsters before the rigging. After the pendants, a strop with a large thimble seized into the after part is usually placed for the spring main-topmast stay to set up to,—the strop itself set up with two lashing eyes before the mast; but this is inconvenient for setting up. A better plan is, to bring the stay down on deck after reeving it through the block abaft the mast, and there setting it up.

The rigging is next set up temporarily, being turned in with spunyarn, and both shrouds of a pair pulled up together; previously setting taut the fore stays if the bowsprit is secured. After the stays and rigging have had a second good pull, each shroud being equally taut, looking out for the mast all the time, mark the rigging off and turn in for a full due.

This is done by seizing a sheer-batten along the rigging, parallel to the chains, and about three feet from the top of the lower dead-eye, which, if it is well stretched, is a good drift for turning in new rigging. Mark the shrouds and take the batten off. Then measure down a couple of feet on each shroud for half the round of the dead-eye, which mark off for the crown of the bend for turning in, and, by strictly adhering to this, you will ensure your rigging being turned in square, and leave the required drift of about three feet from dead-eye to dead-eye.

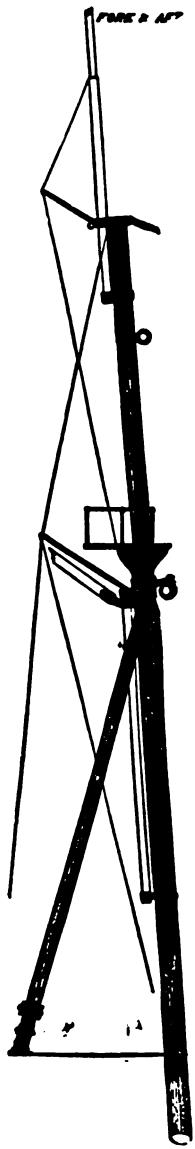
Everything being come up, bring to and steady taut the foremost swifters: then knock out all the wedges, hook a tackle (luff upon luff), from forward to a strop

ıd the mast close down to the deck, and with it and runners and tackles (steadied forward against a stay-le from the mast-head, aft,) bring the mast to its nded rake. Supposing the mast then to be in all iculars well stayed, drive the wedges in, keeping fast tackles till you have done so, taking care not to alter position of the mast; and the wedges ought never to tarted again except to alter the rake. You may then up the fore stays, making a small allowance for the t coming aft as the rigging is pulled up; then set up after swifters against the stays, and the rest of the uds in succession, commencing with the foremost pair.

ɔ. SET UP FORE RIGGING.—The purchase used for ing up lower rigging is an "up-and-down," and a The double block of the up-and-down is lashed oggled to the lower pendant, and the single block ked to a cat's paw in the hauling part of the luff; single block of the luff being hooked to a selvagee p round the shroud, parcelled in the nip, and the ible block brought to the lanyard,—the end of the being used to round down.

The fore-stays are set up in the same manner as the ouds, but the lanyard is middled and set up on both ds; necessitating the use of one luff, and one "up and wn" for each end of the lanyard, the falls must be ten through leading blocks, and kept in a line with the ıys.

On refitting, when in a long summer's day the rigging ould be turned in afresh, fore and aft, if it requires it,

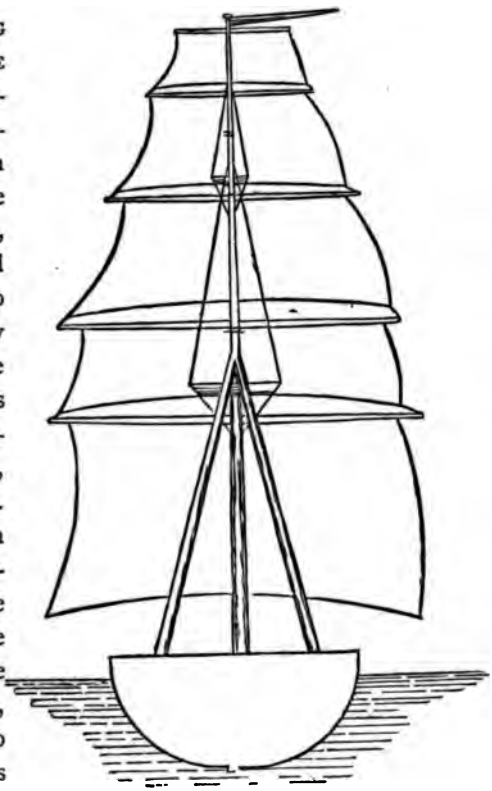


and set up, rattled and blacke
before sunset, the loss of tim
sequent on waiting for the up-and
till the stays are secured is of
ance: therefore, make use of t
tackles, the spans being fitted
hook, and the pendants taken
the mast-head; so that direct
have got enough of the stays,
waiting for securing, start w
rigging. The ends of stays and
are whipped and capped with c

TRIPOD MASTS are of gr
vantage in turret ships dispensi
lower rigging, while allowing gre
of training to the turret guns.

The centre leg of the tripod
ponds with an ordinary iron low
standing nearly upright: the t
legs which take the place of
are fixed to its head below the
trees, having about the same an
the after swifter would have h
the lower ends bolt to an iron
the deck; three or four sm
shrouds are necessary on each
sending men aloft, which bein
with slips, are easily cleared aw

The legs of the tripod may be
before the mast if necessary.



11. STAYING MASTS AND THE USE OF BATTENS.——Conjointly with marks on the deck and masts, battens are used in setting up rigging to show whether the mast requires going to starboard or to port, forward or aft. To cut them, in the first instance, draw a line from the centre of the mast hole across the deck, measure off two equal distances on each side of the mast, and mark the extremities. Take two long battens of equal length, place one end of each on the marks on each side of the deck, and rest the other ends against the mast. Pull the rigging up on either side, till the two ends come abreast of each other, and the mast must, necessarily, be upright. Drive a nail on each side of

the mast and deck for permanent marks, but one batten only need now be retained.

The rake being determined, say half-an-inch to a foot, a plumb-line is dropped from the centre of the mast, from any distance up, and the mast raked till a corresponding is plumbed. If, for instance, the plumb-line is dropped from the trestle-trees at 60 feet, the line must plumb at 30 inches abaft the mast.

"The rake of the masts has reference to the keel; but as the deck and the keel are not parallel, the angle between their planes must be considered, when determining the angle the batten should have to the deck, in order that it may have the assigned angle to the keel."—*(Admiralty Circular, April, 1858.)*

Draw a fore-and-aft line from the centre of the mast, place the end of the batten on it, either before or abaft the mast as most convenient; mark where the ends take the mast and deck with a couple of nails, which, with the side marks and this batten, are for future guidance, it being needed merely to place the batten afterwards against the mast, to show how the latter requires to be moved.*

* The circular, above quoted, states, that, "in consequence of the injudicious manner in which the masts have been stayed, and the lower rigging set up," they are frequently crippled; and provides that "to regulate the setting up of rigging, and to determine if a lower mast is straight, a middle line should be cut on each of its sides and upon the after part. These lines should be painted a different colour from the rest of the mast, and extend from the trestle-tree to the heel. At the upper part of each line a small eyebolt should be

2. OBJECT OF RAKING MASTS.—As the pressure of wind is perpendicular to the plane of the sail, raking its produce lifting sails, though the direct propelling er is somewhat lessened thereby; the loss varying in are sails, as versine of angle of rake.

ly the mizen-mast raking considerably, it the more ctually resists the forward strain brought upon it by its ı braces and those from the mainmast, and at the same e increases the space between it and the mainmast.

ncham says, that "the whole of the masts should e, so that, when the ship is inclined to her most com- n angle, the plane of the sails should be perpendicular the longitudinal axis of the ship, or else part of the e of the wind that acts on the sails must depress the p."

3. DETERMINING RAKE OF MASTS.—Presuming that angle between the deck and keel is so small as not to noticeable in a small distance,—

$$192 : 2 :: 64 : x$$
$$x = 8 \text{ inches.}$$

4. STAYING MASTS IN DOCK.—This of course is

ed, and on the line near the deck another such eyebolt. A rope fastened to the upper one, and rove through the lower, and ed tight, will, if the mast be straight, coincide with the middle cut upon it; or, if not straight, the fact will be evident by the cut and the rope not being parallel. The amount by which llelism is departed from, will represent any curve the mast has n."

preparatory to cutting a batten, which could always be used irrespective of the ship's trim. Supposing, then, that you drop the plumb-line from 60 ft. up the mast,—

$$200 : 3 :: 60\,x\,; \therefore x = 10{\cdot}8 \text{ in.}$$

½-in. in a foot = 30 in. in 60 feet; so 30 in. − 10·8 in. = 19·2 in., the rake in 60 feet, to be given in the first instance—angle between deck and keel as before.

15. Use of the Rubbing Paunch on the Fore Side of Lower Masts.—To protect the mast when striking the yard, and to prevent the yard catching the hoops. The mizen-mast has only a small piece of hard wood in the wake of the yard when up.

16. Small Pieces of Wood round the Hoops of a Bowsprit.—They are wedged-shaped, and nailed on before the bowsprit is got in, to prevent the hoops catching; consequently there is no necessity for them outside the partners.

17. Length of Lower Pendants.—In the first place, to stay the mast, the runner-blocks must be lashed some way down, to keep the mast from buckling: this determines the length of one pendant. Another pendant is required to lash the tackle to, for setting up the stays, and, to bring it in a line with them, must be dipped over the lower yard. This must necessarily be the foremost one, but as it is unnecessary to cut it longer than is required to keep the tackle clear of the yard, it is therefore the shorter of the two. One-third of the length of the mast from deck to trestle-trees is sufficient for the long pendant, and one-third less for the short one.

18. PLACEMENT OF STAYS.—The starboard stays are the standing, and the port the spring stays; for the port go on first, and consequently, being the lowermost, are the proper ones for setting a sail on (if set on the upper stay, the sail would chafe across the lower one). The starboard fore and fore-topmast stays are therefore the upper and outer ones.

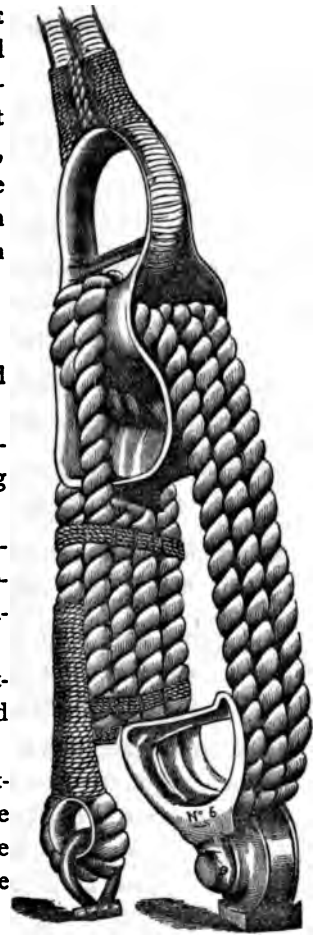
19. STANDING PARTS OF STAY LANYARDS.—The standing part of the lanyard of a bobstay is rove with a running eye round the collar above the heart, and acts as a preventer seizing. The lanyard of a lower stay, being worked on both ends, has no standing part, and, when rove full, the ends are seized to the other parts of the lanyard.

20. COMPARATIVE SMALL SIZE OF MIZEN STAYS.—Because the braces on the mizen-mast, by leading forward, assist the stays.

21. TURNING IN RIGGING CUTTER'S STAY FASHION. —On the starboard with the nip aft—port side, forward; ends, on both sides, inboard. The reason of this is, that rigging should be turned in as the rope would be coiled down, so that it at once accommodates itself to the bend it would naturally take, and no turns are taken out of the lay of the rope. With left-handed rope the same principle holds good, and the result is necessarily

reversed. However, with wire rigging, for the sake of uniformity in appearance, both sides are generally turned in alike, with the nip forward, and the end inside and aft.

22. TURNING IN WITH THE END UP.—With the right-handed rope the end will be, on the starboard side, aft; and, on the port side, forward; crossing inside, this was the old plan, but wire rigging is now often turned in end up, without crossing, with the end inside.



23. LEAD OF THE STAYS:—

Fore stays, from foremast-head to bowsprit, or knightheads.

— topmast stays, from topmast-head to bees, then in along bowsprit.

— top-gallant stay, from top-gallant mast-head to jib-boom end, and dolphin-striker.

— royal stay, from royal mast-head, to flying-boom end and dolphin-striker.

Main stays, from mainmast-head to a cross-piece before foremast, or to bolts in the deck on each side of the foremast.

— topmast stay, standing, from topmast-head over a chock between fore trestle-trees, then down on

deck, or set up to a strop under the eyes of fore rigging.

Main spring, from topmast-head through iron stropped clump-block on foremast, and down on deck.

—— top-gallant stay, from top-gallant mast-head, through hole in fore cap, and set up in top.

—— royal stay, from royal mast-head, through sheeve-hole in chock of fore topmast cross-trees, down through hole in fore cap, and sets up in top.

—— stays, from mast-head, over rollers ten or twelve feet up mainmast, and set up to bolts in partners.

—— topmast stay, from top-mast-head, to strop between eyes of main rigging.

Mizen top-gallant stay, from top-gallant mast-head, through hole in main cap, and sets up in top.

—— royal stay, from royal mast-head, through hole in chock of main topmast cross-trees, down through hole in main cap, and sets up in top.

24. STRONGEST PLAN OF TURNING IN RIGGING.—By experiments on the three different plans it was found that, under the pressure of a breaking strain, a shroud first gives way at the splice. The next weak point was found, in the cutter's-stay plan, at the nip. The old plan broke at the main part of the rope, at the maximum strain, which, when the seizings are carefully put on, is therefore the strongest; but, by the working of the ship the seizings are

le to slip, and more strain is brought on one part than
:her, which is the reason that the cutter's-stay plan has
ı so generally adopted.*

5. THROAT SEIZING.—The end of a throat-seizing is not
off after the knot is formed, but two or three feet are
and expended round the shroud below the seizing;
if cut off, there would be no end to work with on turn-
the rigging in afresh. The knot of the seizing is
erneath.

6. LANYARDS OF LOWER RIGGING.—Are spliced round
ıimble in an eye-bolt in the chains, inside the dead-
; before the dead-eye on the starboard side, and abaft
the port side; then through the foremost hole in the
d-eye (starboard side), from in—out, and when rove
, the hauling part will be found under the standing part
he shroud; for there it is that the first and greatest
in comes when setting up, which, if the lanyard were
e any other way, would be brought on the seizing, and
ıld moreover cause the dead-eye to slew. By bringing
standing part to the chains, the purchase is increased;
l the tendency to capsize, which dead-eyes in new
ging are liable to, is counteracted. Lanyards are half
: size of the shroud, supposing the latter to be hemp.

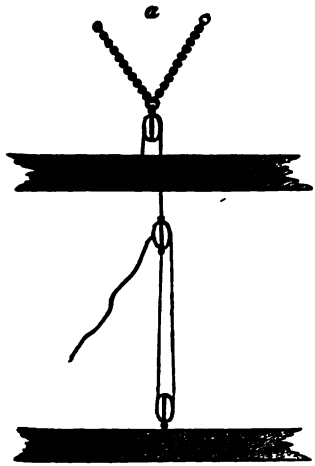
27. TO BRING TO.—A couple of turns of the lanyard
: taken round a large toggle; a strop is then middled,
d a turn taken with it round both parts of the lanyard
ıder the toggle, and the luff hooked to the bights.

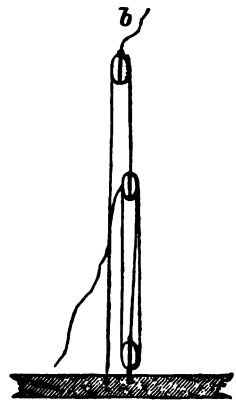
*Tinmouth.

28. RACKINGS ON THE LANYARD.—Are taken off, at first, to bring an equal strain on all parts; and, when everything has settled well into its place, two or three seizings are put on every two parts, that when the ship, working heavily, slackens the lee rigging and brings up again with a jerk, the strain may come at once on all parts of the lanyard, and not on each part in succession.

29. TACKLES.—The power gained by them is as the space travelled over as you walk the weight up, to the space travelled by the weight at the same time, which, in simple tackles is as the number of parts at the movable block. For instance, in a single whip no power is gained, the direction only being altered for convenience in working. In a double whip the power is doubled; in a gun-tackle purchase, with the standing part at the movable block, the power is trebled; and the same with a luff or burton, with the double block stationary; in a side tackle with two double blocks, the power applied is increased fourfold; and so on. In a port-tackle fall, *a*, it is first of all doubled by the runner, then trebled by the tackle, which gives $2 \times 3 = 6$, the whole power gained. In a runner and tackle, *b*, $2 \times 4 = 8$; that is, five men on this purchase will lift as much as forty men on a single rope. Luff upon luff gives an increase of 16 times; another luff added, 64 times; and so on. But this is purely theoretical, and, for practical purposes one-fourth should be subtracted for ordinary tackles, and one-third for a three-fold purchase, as an allowance for friction; and when the hauling part, coming from the movable block of

a tackle, is not parallel to the tackle, there is a further loss of power = tension on hauling part × cosine of the angle.



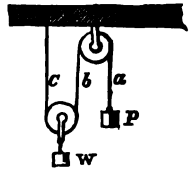


One great advantage of a tackle on board ship, which renders its application of constant occurrence when mere power is not wanting, must not be overlooked; as, for example, when sudden hoisting or jerking is to be avoided, and a steady, gradual strain is required, as in staying a mast. Another advantage of a purchase, when fitted to any part of a ship's rigging, is that on *coming up*, when some little must necessarily be given back, only a mere fractional part is lost on the rope itself; as in the lanyard of a dead-eye, the purchase fitted to an after main brace, &c.*

* From "Tate's Mechanics" is taken the following clear explanation:—

"*Ex.* 1. In the annexed system of pulleys if W = 2 lbs., required P, when equilibrium takes place.

30. SPANISH BURTONS.—A single Spanish burton, 4, has two single blocks, the standing part spliced into the strop of the movable block, and the bight seized or bent to the hook. This increases the power three times.



Here, as W is suspended by two cords, *c* and *b*, each cord will carry 1 lb., but as the cord is supposed to have a free motion over the wheels, the portions *a*, *b*, and *c*, will have the same stretch or tension; therefore P must be 1 lb.

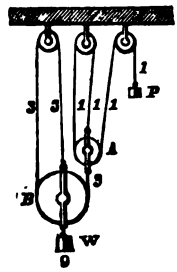
Let us now consider the equilibrium on the principle of the equality of work.

If W ascend 1 foot, the cords *c* and *b* will each be shortened 1 foot, and therefore P must descend 2 feet; hence we have,—

Work of P = P × 2, and work of W = 2 × 1,

$\therefore$ P × 2 = 2 × 1, and P = 1 lb."

"*Ex.* 2. In the annexed system of pulleys, if W = 9 lb., required P, when equilibrium takes place.

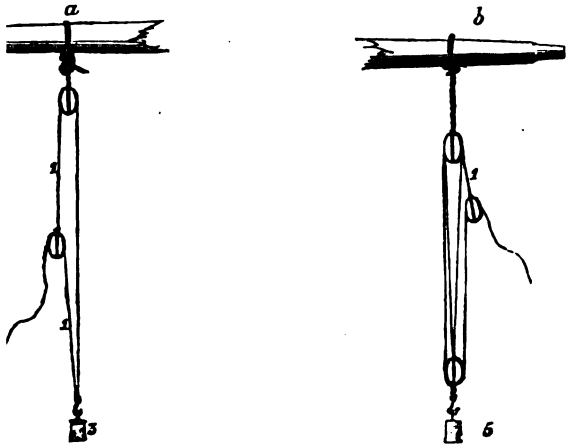


Here the three cords marked 3, form a continuous cord, hence they will each sustain the same stretch; and in like manner the four cords marked 1, will each sustain the same stretch. The weight W, with its pulley B, is supported by three cords, therefore each cord will carry 3 lbs.; there are therefore 3 lbs. suspended from the pully A. Now the pully A with this weight is supported by three cords, therefore each cord will carry 1 lb., hence it follows that P must be 1 lb.

Or thus on the principle of work:—

If W ascend 1 foot, the pulley A will ascend 3 feet, because each of the three cords marked 3, will give off 1 foot of cord; in like

e double burton, *b*, has one double and two single s; the standing part spliced into the strop of a single , then rove through the double or fixed block, and the seized to the strop of the lower block, to which the t to be lifted is hooked. The end is then rove up gh the double block, through the lower, and lastly gh the single block to which the standing part is



ed. This purchase gives an increase of five times the r applied.

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r, if the pully A ascend 3 feet, the weight P must descend 9 ecause each of the three cords marked 1 will give off 3 feet of Thus it appears that while W ascends 1 foot, P descends 9 hence we have by the principle of work,—

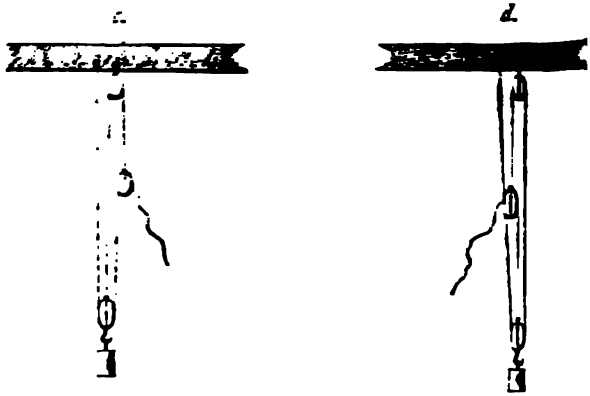
Work of P = P × 9; work of W = W × 1,

$\therefore$ P × 9 = W;

and if W be 9 lbs., then P = 1 lb.

precisely the same manner the equation of equilibrium may be mined for any other system of pulleys."

Other Spanish burtons, *c d*, are formed of single blocks which quadruple and quintuple the power respectively.



31. STANDING PART OF A TACKLE—Should be on the side of the block, opposite to the hauling part, as it thus leads fair, and counteracts the tendency of the hauling part to slue the block.

32. TO FIND WHAT SIZED ROPE YOU REQUIRE, WHEN ROVE AS A TACKLE, TO LIFT A GIVEN WEIGHT.—Divide the weight to be raised by the number of parts at the movable block, to obtain the strain on a single part; add one-third of this for the increased strain brought by friction, and reeve the rope of corresponding strength.*

One-sixth of 40 tons is 6⅔ tons, which, with one-third added, is 9 tons nearly; for which you should reeve a 6-inch or 6½-inch rope

* Table III.

Conversely:—To find what weight a given rope will lift, en rove as a tackle;—multiply the weight that the rope apable of suspending by the number of parts at the vable block, and subtract one-fourth of this for resist-e.

1.9 tons, the strength of the rope, multiplied by 6, the nber of parts at the movable block, minus 13.3 or one-rth, gives 40.1 tons as the weight required.

33. WIRE ROPE is more than twice the strength of np rope of the same circumference; splicing a rope is posed to weaken it one-eighth.

34. TO FIND THE LOSS OF SUPPORT CAUSED BY THE GLING OF A STAY.—Sine of angle × tension = effective ce,* which, in this case, will be found to be 5·8 tons, owing a loss of nearly one-third.

35. DISTANCE OF RATLINES APART—Is fifteen inches: tch-ratlines every fifth.

36. HOW SEIZED ON.—Splice the seizing of two-yarn ttle-stuff into the eye of the ratline; pass it round the roud, through the eye, *back* round the shroud, and so n; the eye lying athwartships.

The hitch crosses outside, for, when you stand on the atline, it remains firmer, bearing against the shroud, than f hitched inside.

* Tinmouth.

37. SQUARING RATLINES.—In this case take two or three turns in the lay.

38. GAMMON AND RIG A BOWSPRIT.—If there are two gammonings to be passed, which is the case in large ships, not fitted with running in bowsprits, the outer must be passed first, or, from its greater leverage, it would slacken the inner.

The gammoning is chain, and the standing part is shackled round the bowsprit, close down to the after part of the saddle; which, with the hole in the cutwater should be well greased. A turn is then passed through the hole in the cutwater at its foremost part and hove taut, as many thoroughfoot turns as can be taken are passed; each turn as it is passed is hove as taut as possible with a pendant, and strong purchase brought to a capstan, and racked by driving nails through the links into the bowsprit. The end is expended in racking turns passed up towards the bowsprit, and the whole is covered with lead.

If thoroughfoot turns were not passed, the outer turns would first feel the effect of the bowsprit working with the pitching of the ship; but, by the inner turns on the bowsprit becoming the outer ones in the cutwater, the strain is equalized: also with a bowsprit of much steeve, the turns would have a tendency to slip down, if passed round and round.

Iron bands screwed down over the bowsprit to the knight-heads, take the place of gammoning in many ships.

Few ships have their bowsprits clothed exactly alike, but

wing is the general plan :—At one-third in from
he rigging cleats are nailed round the bowsprit ;
rigging is placed in the following order :—Inner
collar, inner bowsprit shroud collars, inner fore-
ır, middle bobstay collar, outer bowsprit shroud
outer fore-stay collar, outer bobstay collar.

rly the end of the bowsprit the iron stropped heart
ıp bobstay shackles on.

bstay Collars are wire, with an eye spliced into
; a heart seized into the centre, and the eyes lashed
with a rose lashing on the top of the bowsprit.

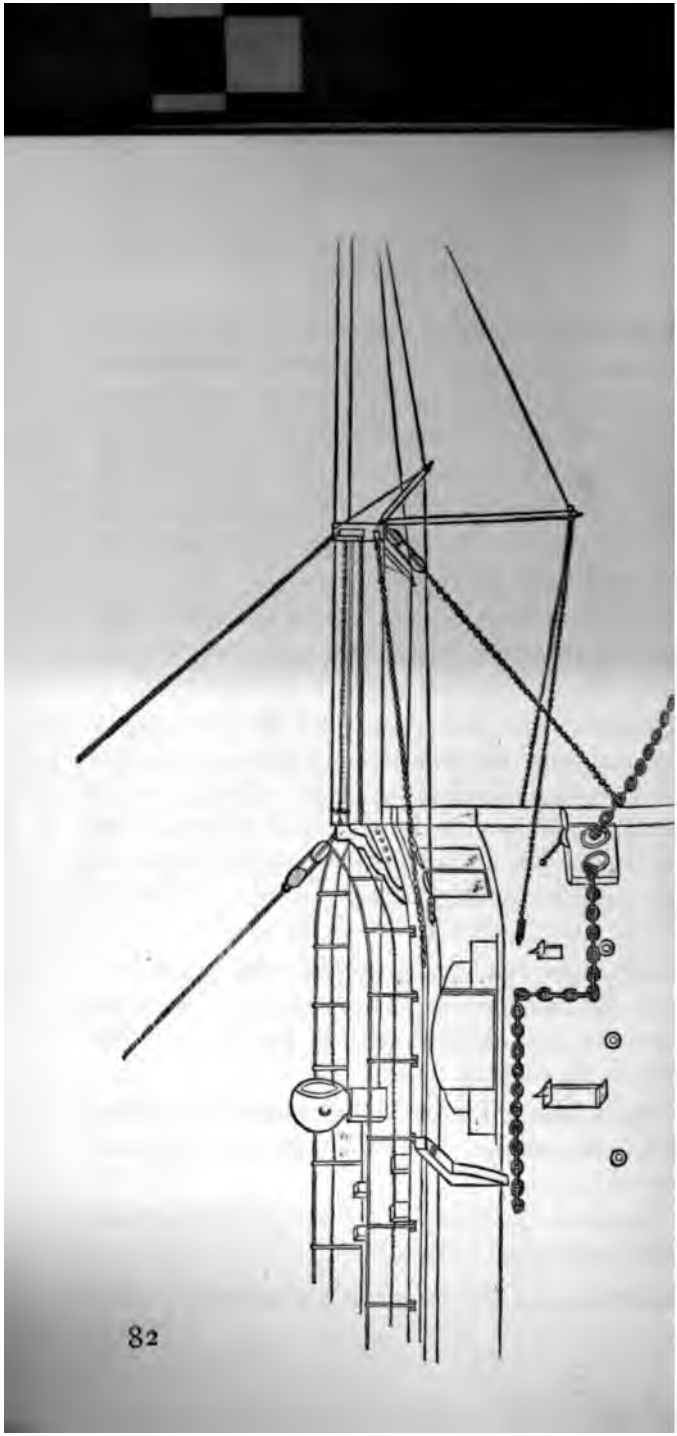
rit Shroud Collars are fitted like the bobstay
ut with a long and short leg lashing on the top
wsprit. A fore-stay collar is a wire strop with a
ed into one end ; the other bight is taken round
e bowsprit and lashed to its own part below the
ich is chocked to keep it at the side of the

ys are wire strops, spliced after being rove
the cutwater ; the heart is seized in with the
its top, and both parts of the bobstay seized
at the cutwater.

rit shrouds are single wire, with a heart spliced
outer end, and fitted with a slip to a bolt in the
he other.

is now rapidly taking the place of wire rope, for
shrouds and bobstays

BSTAYS.—The inner bobstays are set up before



those further out, otherwise you would he unable to work at the inner ones.

40. SETTING UP A BOBSTAY.—The single block of a luff is hooked to a cat's-paw in the lanyard, the double block to a selvagee round the bobstay, the hauling part through a leading part on the bowsprit—led inboard, on to which another luff, or up-and-down, is capped along the bowsprit.

41. RUNNING IN BOWSPRITS.—Ships intended to be used as rams, are usually fitted with running in bowsprits, which are of wood, and four-sided, the heel is kept in place between bitts fitted on the forecastle and with a slip fid; chocks are bolted to the knightheads, and the bowsprit runs out between them over a roller let into the stem head, and is kept down by an irou band which goes over it, screwing down to the chocks.

The bowsprit cap is iron, with bolts for the whiskers, and dolphin striker on it; also two snatches, or iron-bound sheaves for the top-mast stays; inside the cap are iron-bound hearts for the bowsprit shrouds and bobstay to set up to.

Bobstay and bowsprit shrouds are chain, and the standing parts secure with slips to the bows, setting up to the bowsprit with a lanyard in large ships, but in some small vessels it is simply fitted with a screw, which can be tautened up at pleasure with a lever.

42. GETTING IN MAIN YARD FROM THE JETTY.—Ship lying starboard side to the wharf. Reeve the jeers with the standing part aloft, leaving a sheave out of the upper

block, and take them to the capstan, or, if more convenient, through a block at the edge of the wharf, and take them to one of the capstans at hand. Hook up-and-downs to strops out on the quarters of the yard; and to the slings hook a sail-tackle, taken to a bollard ashore and hauled taut. Bend a single guy to each yard-arm, take a turn with them, and heave round the jeers. Pull upon the port up-and-down, to clear the fore rigging, and ease away the port guy, holding on the starboard guy and sail-tackle. When clear, sway the yard across the nettings with the jeers and starboard tackle, easing and working the guys as necessary.

43. MAIN-YARD IN THE WATER ALONGSIDE.—Coming in on the starboard side, haul the yard up with the port yard-arm forward; lash the jeer blocks to it, and reeve the jeers in the foremost or port block, and secure the standing part round the yard, making three parts.

A jib-boom, mizen topmast, or fish davit may be used as a derrick, the former will, I think be found the most convenient. Get up the largest hawser your jeer and top blocks will reeve; use an up-and-down for a derrick topping lift, with its double block lashed to one of the masthead pendants; hook a top block to the other pendant, reeve the end of the hawser through it, through a top block lashed to the derrick head, through the starboard jeer block on the yard, and secure the end outside all, at the head of the jib-boom.

Raise the derrick with the up-and-down, lash the heel, and put a luff on as a martingale.

Get a sail tackle on the foremost yard-arm as a guy, a rope's end will be sufficient for the after arm. When already, sway the yard clear of the netting, with the hawser, taking down the slack of the jeers, then haul away foremost guy and jeers, ease the hawser, and when the yard is athwartships, land it on the netting. If necessary, use top burtons as preventer lifts in placing the yard. Reverse the operation in getting the yard out.

44. RIGGING MAIN YARD.—Centre the yard and place the slings, and, on either side, jeer blocks and topsail sheet blocks; truss strops. The clew-garnet block on the quarter, and further out the quarter strop for the rolling tackle.

Yard-arms.—Foot rope, jack-stay, head-earing strop, dog strop for yard tackle pendant, dog strop for preventer brace, dog strop for the after main brace, lift block, standing part of lift, sheet stopper, and standing part of topsail sheet.

The Slings—Consist of two pieces of chain, the foremost ends connected to a large ring, through which the after ends reeve; these join in a long link, to which the slip is attached.

Jeer Blocks—Are single blocks fitted with two single strops of different lengths, to allow the sheeves to lie fore and aft; the foremost strop is the shortest, and the strops are lashed together with a rose lashing on the upper forequarter of the yard. The short jeers are generally kept rove as preventer slings.

Truss Stops—Are chain, with their ends lashed on the

top of the yard, one of them on each side has a fair-lead for the hauling part of the truss; the standing parts standing to the other, on opposite sides.

Topsail Sheet Blocks—Are fitted with a double strop which lashes on the top of the yard; a lashing being passed between them below the yard, to prevent the blocks slipping outwards.

Clewgarnet Blocks—Are best fitted if stropped, with sennit tails to nail round the yard, the block lying well up on the quarter, the standing part of the clew-garnet is secured with a timber hitch outside the block. The quarter strop is a grummet strop with a thimble seized into it.

Yard-arm rigging—foot-ropes are fitted with an eye over the yard-arm, and a small eye in the other end at convenient distances; the foot-rope is kept up by stirrups, through which it is rove; their upper ends going over the jackstay bolts. The jackstay is wire, and goes with an eye over the yard-arm, reeves through the jack-stay, bolts on the yard, and lashes to the end of the opposite jack-stay in the bunt.

The dog-strop for the yard tackle pendant is a single wire strop; the pendant is wire, and one-quarter the length of the yard; is spliced into the dog-strop, with a fiddle-block in the lower end.

Brace Blocks.—Take two coupling thimbles, into one splice the single wire dog-strop; to the other splice a double strop, into which seize the brace block, so that it will tie with the sheave horizontal.

Lift Block.—A single block, single stropped, with an

ye to go over the yard-arm; the standing part of the lift i fitted with a running eye.

The leech-line blocks—two on each side before the sail, re tailed and hitched to the jackstay; from these the ech-lines reeve through a double block toggled under ie top, and thence down on deck—abaft. The slab-line locks—two on each side abaft the sail, are secured like ie leech-line blocks; and the slab-lines when rove hrough them, lead down before the mast through small ouble blocks. At the length of the yard-tackle pendant n from the yard-arm there is a cheek for the quarter ricing-line and the bill-tricing line is rove through a block n the slings.

45. LOWER BRACE BLOCK.—The side which has the square head of the bolt in it is the uppermost, to prevent the bolt working out.

46. DIFFERENCE BETWEEN LOWER AND TOPSAIL BRACE-BLOCK STROPS.—A lower brace block is fitted with a double strop, topsail brace block with two single strops. The former—to make the block lie horizontal, the latter—vertical.

47. LOWER LIFT-BLOCK.—The hauling part of the lift should reeve through the foremast sheeve, for, if through the after one, it would, on bracing up, bind against the lee rigging and prevent its being overhauled.

48. DIFFERENCE BETWEEN FORE AND MAIN-TOPMASTS. —In a fore topmast, the live sheeve is cut from the port after quarter to the starboard fore quarter, and in a main-

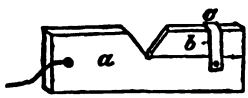
topmast, from the starboard after to the port fore quarter.

49. HEELS OF TOPMAST AND TOP-GALLANT MASTS.—If a spar were used large enough to allow the heel to be cut out of the solid, the most important part of the mast would be formed of the core; thus, a mast of this description would be considerably weaker than one formed of a smaller spar: and moreover, as the younger a spar is, the greater is its comparative strength, owing to its greater compactness (which may be seen by comparing the specific gravities of large and small timber), so the greater is the inducement to employ small spars when applicable for this purpose.

50. SHOULDER FOR THE CAP, ON THREE SIDES OF A MAST-HEAD.—This allows you to make the after side more wedge-like, by giving more to cut away on; and this form prevents the cap from drooping forward and also from jambing.

51. FIDS.—A topmast fid is of solid iron, with a hole in the end through which is spliced a strop for a jigger to hook to for unfidding—assisted by the top maul.

A top-gallant fid is composed of *a*, the fid, and *b*, the shoe. An iron band *c*, with a pin through the fid, keeps the shoe in its place. The upper part of the fid-hole in the mast is cut so as to dovetail in between the fid and the shoe. By the working of the mast it is, therefore, impossible for the fid to work out.



52. GETTING MAIN-TOPMAST ON END.—Lying on the starboard booms, with head aft. Hook the top blocks, reeve a 7-inch hawser through the starboard block, overhaul it down and hitch it through the live sheeve round the heel of the mast, and pass a lashing round the head of the mast and hawser about a third down, which drift is necessary to allow the mast-head to be swayed up outside the top (being hauled forward by a main top-bowline); should it be requisite to lower it down the main hatchway previous to pointing its head between the trestle-trees. Get up and lash the starboard fore up-and down, and hook it to a strop through the fid-hole. Brace the main yard sharp up on the starboard tack, bring the hawser to the capstan and run it round, easing away the fore tackle. When the topmast is up and down the mast, land it on the deck, unhook the fore tackle, steady the head, slack up the lashing, double the hawser, and sway up high enough to reeve the port top-tackle pendant over the dumb sheeve—well smothered in grease, the upper block being rounded close up to the futtock rigging. You are now ready to sway away and fid.

It may be swayed up from alongside in the same manner.

53. GETTING A LOWER CAP OVER.—Main. Sway a top block up by one of the gantlines, and lash it on the starboard side of the mast-head; reeve a 7-inch hawser through it, overhaul it down, bend on, and sway the cap into the top—(outside all, guying it clear by a fore-and-after, for it will not come up through lubbers'-hole),

and place it fair for receiving the head of the topmast. Then overhaul the hawser down again, get the topmast up and down, double the hawser—rove through the live sheeve, and, if high enough, lash the cap, by middling the lashing, clove-hitching it round the mast-head over the cap, reeving each end through the foremost bolt in the cap, its own side—round the mast-head, through the after bolt in the cap, back round the mast-head, and so on till enough turns are passed. Place a capstan-bar in the fid-hole, with a slue-rope bent to it; sway away, slue the topmast, and lower until the cap is on, when place the capshore.

The same means are employed for sending the cap down, but a capstan bar, slung by one of the gantlines abaft the mast-head, is used for a bumper; the gantline worked on deck.

54. SENDING TOPMAST CROSS-TREES OVER.—Main. Sway the topmast six or seven feet above the cap, and lash the gantline blocks on each side of the topmast-head well up. Up-end the cross-trees abaft the mast, as in sending a top over, bend the gantlines, led underneath, to the after horns, close to the trestle-trees, and stop them up to the foremast horns. Bend a guy from the mizen-mast-head to the fore part, to keep them clear of the top, sway away, and land them on the cap. Bend a couple of bell-ropes to the foremast horns from the top, to steady them, cut the stops, lower the topmast, haul over on the bell-ropes;—keeping a strain on the gantlines, and the cross-trees will fall over the mast-head; then unlash the

gantline blocks, and let the cross-trees come down into their place.

SENDING TOPMAST CROSS-TREES DOWN.—Strip the mast, sending down the cap and hanging blocks, unfid and lower it until the cross-trees are one fathom from the cap. Stopper the hawser, and belay it with two fathoms slack—(the distance of the cross-trees above the cap being measured and sent down from aloft to guide you). Off stopper, and bump the cross-trees to start them. Lower the mast and land them on the cap. Pass the ends of the lower mast-head gantlines over the lower lift blocks :—from aft, forward (main topmast cross-trees), and bend them to the cross-trees. Bend one of the fore gantlines or a main-top bowline, to the fore part ; haul taut the gantlines and take a turn with them. Ease the cross-trees down off the cap—(the gantlines lying over the lift blocks preventing them falling far), haul forward on the bowline, and when clear, lower away. Lower the fore topmast cross-trees down abaft, with one of the main gantlines for a fore-and-after.

55. RIGGING AND STAYING FORE TOPMAST.—After the cross-trees are on, the topmast is rigged in the following order :—necklace, bolsters, grummet, mast-head pendants, shrouds, backstays, topmast stays, jibstay.

The Necklace—Is a chain strop round the mast-head under the bolsters, with two short legs on each side ; the hanging blocks shackle to the two after legs, and the jib and fore-topmast staysail halyards to the foremost legs. To send the rigging over, shift the gantlines to the after

cross-tree, and put the rigging over in the same manner lower rigging, only in the order given above.

The pendants are wire, have but one leg, and f with a cut splice; the rigging is also wire. The t blocks should be seized in between the foremost shr below the seizing, before sending them over.

The rigging being over, the topmast cap on, and ha blocks shackled, fid the mast, get up and steady taut th tackle, hook the top burton to the pendants, stay the and proceed to set up the rigging. For which use a r and top burton; the runner fitted with a selvagee t one end, and a thimble on the other, rove through a stopped with a thimble, the lanyard is bent to the th the tail of the runner clapped on the shroud, an single block of the burton hooked to the thimble pendant; pull up and beat down the shrouds succes fleeting the runner as required to each shroud, and t the backstays. The topmast cap may either be sec by gantlines on the topmast head, bent to the fo bolts, and stopped up to the after, going up before else, the mast lowered after the rigging is sent ove the cap placed on the top of the rigging, fair for sr through.

56. Sister Blocks in Topmast Rigging.—The most pair of shrouds are seized together with a seizing; the block is then put in, and secured in its by slighter seizings round it and the rigging.

57. Lead of Topsail Lifts and Reef-Tackl When the yard is braced forward, these ropes lie

cross the cheek of the block,—a most injurious lead when hauling out the reef-tackles in a gale of wind, and the yard is obliged to be braced by, or at all forward. So instead of the sister block in the rigging, fit a fiddle block to a short pendant spliced into a bolt driven into the trestle-trees; or, if you use a sister block, let it be a swivel one in an iron frame.

58. RIGGING A TOPSAIL-YARD.—The yard in the centre has two iron bands, with eyes on the top of the yard, to which the halliard blocks shackle.

Parrall.—Measure five and a half times round the mast; take once and a half for the short legs, and the remainder for the long legs, splice an eye in each of the ends; seize the legs with their centres together, pudding, parl, and cover with leather. The long legs are passed under the yard, and the eyes are lashed to the eyes of the short legs on the upper after quarter.

The Slings—Are fitted with a running eye round the yard, (outside the tye block on the side the yard comes down), and a standing eye in the end for the sail-tackle, to hook to; then taken over to the other quarter, and secured by a lizard (through the thimble of which the slings are rove), brought through the quarter-strop, and passed with half-a-dozen turns round the yard and slings.

Quarter-strop.—A single strop spliced round the quarter of the yard, with a thimble seized into it.

Quarter Blocks—Are double blocks, with single strops, having an eye in each end, and lashing on the top of the yard with a rose lashing.

Yard-arms—Are rigged in the following order:—F rope; head-earing strop; jackstay; dog-strop for brace; lift block strop; flemish horse; jewel bl and boom iron.

Foot-ropes—Go with an eye over the yard-arm, through the stirrups, and seized to the yard on opposite quarter; turks-heads should be worked on side of the stirrup, as they prevent the foot-ropes f into long bights; and if the latter carry away, they not unreeve to the hazard of men's lives.

Jackstays—Are wire—go with an eye over the arm, and lash together in the bunt of the yard. Do lift block strops are single wire-rope, with a thimble into them.

Flemish horse.—Thimble over the goose neck round the yard, three or four feet inside the foot Jewel block is stropped with a thimble, which goes the goose neck.

The foregoing is the ordinary plan of fitting yard-arms, but a much better and far more simple has been adopted lately; viz., have an iron band the yard-arm, with bolts for the lift and brace (which must be fitted with clip hooks) to hook to jackstay may be fitted with a small eye splice to g the eye on the band for the lift block, and the foo goes over the goose neck; doing away with the f horse.

Reef tackles instead of reeving through the she the yard-arm, being rove through a snatch. There c

comparison in point of time between this plan and the mentioned, in shifting topsail yards.

9. RIGGING OF JIB, AND FLYING JIB-BOOMS, WHIS- ts, AND DOLPHIN-STRIKER.—*Jib-boom :*—Heel secured a heel chain shackled to a bolt in the cap, placed in score, and secured with a slip shackle to a bolt in the r side of the cap: it rests in a saddle, and is kept n by a chain crupper, also fitted with a slip shackle. unnel goes over the head of the boom (generally), on ch the rigging is placed in the following order :—Foot- es, martingale, guys, jackstay, flying boom-iron, fore -gallant stay.

Foot-ropes—Go over the funnel with a cut splice, then pped out to the guys, and the after ends lashed to ts in the cap.

The Martingale—Is fitted with an eye over the boom l dolphin striker ends, and is either wire-rope or chain.

Jib-guys—Are fitted with an eye over the boom, and isker-ends, and are set up by hauling on the whisker- ys. The jackstay is wire, goes with an eye over the ging, and sets up to the cap. The jib-guys and martin- le—if of chain—shackle to bolts in iron bands, at the -boom, and dolphin striker ends.

Flying-boom.—Foot-ropes, guys, martingale, and fore yal stay in the score. These are fitted as in a jib-boom ; hide funnel may be used with advantage, the rigging ing sewed to it.

Whiskers.—Jib guy, whisker guy, jumper, lift, flying guy

through a hole in the whisker-end; and half-way in, there is a block for the flying jib-sheet. The jumper is fitted with an eye over the whisker end, and sets up with a thimble and lanyard to a bolt in the cutwater. Whisker guy, as the jumper, but sets up to the bows. Lift, the same, and sets up to a bolt in the cap. Flying guy, with a thimble and lanyard to the bows. The fore guy (of lower boom) sometimes reeves through a block on the whisker end.

Dolphin-striker.—Jaw-ropes, jibstay through a sheeve-hole a few feet below the bowsprit. At the end, grummet; back-ropes, middled, crossed, and seized; jib-martingale, fore top-gallant stay, flying martingale, and royal stay—through sheeve-holes.

60. JIB-TRAVELLER.—When shifting the jib in bad weather with the ship pitching heavily, you can lash the tack, &c., on the bowsprit, the traveller being run in to the cap, and afterwards hauled out; or, if the boom complains, you can set the jib half-way out, but in this case you should be prepared with a shifting martingale (a burton, or one regularly fitted). In a small vessel a traveller is very handy, when in rough weather, on a dark night, laying out on the boom to stow the jib is no very enviable duty.

61. RIGGING OF FORE TOP-GALLANT AND ROYAL MASTS.—The flying-jib halyard block strop first goes over the funnel on the top-gallant-mast-head; then, fore top-gallant-stay with an eye splice; flying jibstay the same; starboard and port pair of shrouds and starboard and port pair of backstays, the foremost generally fitted as a breast

ckstay : over the rigging are lashed the blocks for top llant-studding-sail halyards.

Top-gallant rigging should be set up on the bight; the per block of the burton fitted with a thimble, through ich one shroud is rove, and spliced into the other, well clear of the thimble; the lower block hooked to the es of the rigging close down; the fall always kept rove, d payed down on deck when wanted. When the upper ock is seized into the bight of the rigging, it is apt to ing an unequal strain on the shrouds.

Royal-mast.—Stay; starboard pair of backstays; port pair of backstays;—the foremost as breast backstays; uck.

A false royal mast-head, hollowed out to receive the op of the royal pole, which is cut away to fit into it, is used : he rigging and truck are placed on it, and consequently re not disturbed when shifting the mast.

It is now a common practice to split the head of the oyal-mast sufficiently to allow the bight of the royal yard ope to un-snatch when the mast is lowered, instead of unreeving it.

62. A TOP-GALLANT STAY—Being placed below the igging allows the royal to be cut with less roach than it would have if the stay were above.

63. JACKS AND JACK BLOCKS.—Jacks are small iron horns, projecting from an iron band, which is bolted to the im of a top-gallant funnel. They are principally intended o stand on when crossing royal yards, &c., and are of

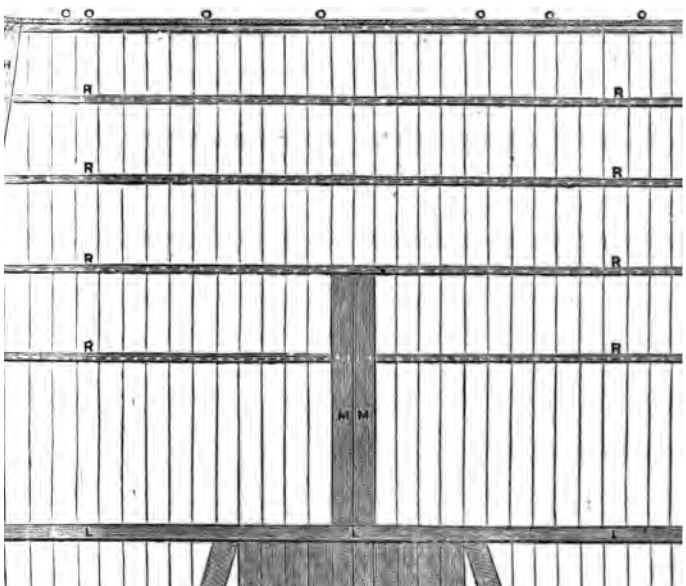
great assistance in sheeing the rigging square when sending up top-gallant masts. The iron band being fitted with eye-bolts, the span blocks, top-gallant buntline and flying jib halyard blocks can be shackled underneath the rigging, which considerably lightens the appearance of the mast-head. The horns are curved aft to keep clear of the royal when set; and the iron band on the hounds of the top-gallant mast is notched on the fore part, into which a tooth in the iron ring of the jack slips, insuring the funnel being properly placed.

Jack blocks are occasionally used to dispense with the necessity for unreeving the yard-rope, when shifting the mast; and are lashed round and underneath the rigging, the yard-rope being rove in them, instead of through the sheave in the mast.

64. SENDING STUDDING-SAIL BOOMS ALOFT.—Topmast-stud ling-boom:—Pay a rope's end down from the top, and bend it to the bolt in the heel: put a whip on the topsail yard to plumb the quarter-iron and bend it to the boom amidships, hitching the heel-lashing to it, to prevent it slipping out; stop the whip out to within three or four feet of the boom-ends, and sway away. Bear the boom-end clear of the topsail-yard, and, when the stop is up to the block, haul up as much as you can get of the heel-rope, take a turn with it, walk back the whip and land the boom across the quarter-iron: cut the stop, pull up on the whip and heel rope, and launch the boom out.

Top gallant boom.—Haul it up into the top, heave a gasket or end of an earing down from the yard-arm, and

NINGS OF **A TOPSAIL.—The upper corners are called the head earings, and the lowe**



66. LININGS OF A COURSE.—The upper corners are called the **head earings, and the lower the clews.**

nd it to the boom-end; toggle the boom tricing-line, ce up, and haul out.

Lower booms are got out, abaft the fore rigging, by a hip on the fore and main yards.

67. FIT A TOPSAIL.—Stretch the head of the sail along, t robands to the eylet holes in the head; the head earings) their cringles. Along each reef band fit the reef-lines, id from the head down the reefs, fit spilling lines.

On the leeches fit third and fourth reef-earings, bowline ridles; span for large reef tackle; beckets and toggles r small reef tackles. In the centre of the sail fit the ckets for the bunt jigger, sew the gaskets on along the ad; splice the buntline toggle strops into the foot, and ize in the toggles.

To fit the reef-lines, a small line or *jackstay* is turned to the leech, level with the reef band, on the after side the sail; another line is then run along the fore side, rough each eyelet hole, and round the *jackstay* abaft, uling taut through each time so as to form a jambing tch in the eyelet hole; the ends are secured to the leech pes.

Beckets and toggles must be fitted to the jackstay, on e topsail yard.

The two midship robands are always made larger than others, to distinguish the centre of the sail in bringing to.

68. FIT A COURSE.—Stretch the head of the sail along, the head earrings and robands, put four toggles on foot for the buntlines, and two on each leech both re and abaft all, for the leech and slab lines to toggle

on to. A course has only two reefs, which should be fitted in the same manner as those of a topsail.

69. REEFS OF FORE-AND-AFT SAILS.—The points are *crow-footed;* which is done by stabbing a hole in the sail, middling the point, and ing it against the lay, so as to work the strands out i ps. Put one end of the point through the sail, keeping the ops on one side, which stitch to the sail—one bight be n the upper part of the hole, and the others on each sid nd each point on a seam.

70. BOWLINE AND R CRINGLES.—Reef cringles, and reef-tackle bridle-cringles have thimbles, which bowline cringles do not require.

71. BOWLINE BRIDLES.—That of the foresail has two cringles; mainsail three; foresail three; main-topsail usually four. It is a good plan to have the toggle on topsail bowline bridles, fitted with a long drift, as it gives great facility for bending or unbending the bowline, in the top or on the lower yard.

72. CRINGLES IN LEECH OF FORE AND MAIN-TOPSAILS.—The number is the same in each; for, in the fore topsail, the reef-tackle bridle hitches to a separate cringle; but in the main-topsail, to the upper bowline cringle.

73. DIFFERENCE BETWEEN CLEWS OF TOPSAILS AND COURSES.—Courses have a clew-rope.

74. HEAD AND LEECH-ROPES OF A SAIL.—The head cringle is first made by splicing an eye in the end of the leech-rope; the head rope is then passed between the strands of this cringle, and spliced into its own part.

75. LEECH AND FOOT-ROPES.—These are spliced together, just below the lower bowline cringle, with a sailmaker's splice.

76. SAILMAKER'S SPLICE.—When a large and small rope are to be spliced together, and they require tapering off to blend their sizes, as in the leech of a topsail, a sailmaker's splice is used.

To form it; unlay enough of the small rope to put the ends in once and a half; but of the large one, unlay for a considerable distance, according to the relative disproportion of the ropes, and the degree of tapering you intend to give them; open out, and bring the parts together, as for a common splice.

Then take a strand of the large rope, cut away about a fourth—from underneath—and put it, *left-handed*, through the corresponding strands of the small rope; cut away a few more yarns, and pass it again, back-handed, *round the same strand* of the small rope; and so proceed—working with the same strand of the large rope, round and round the same strand of the small one, cutting away gradually till it is reduced to nothing. Then, one at a time, put the other large strands through in a similar manner, cutting away more or less of the third strand, as may be necessary to give roundness to the splice. Finally, slue round and splice the small strands into the large rope, as in a common short splice.

77. CUT OF TOPSAILS.—If topsails had a straight leech, a greater length of yard-arm would be required to take the reefs in.

you, and in the same way sew the edge of the first cloth to the double part of the second; rub down, and it will appear as at *c*.

87. HERRING-BONING.—Is used for stitching up rents and small holes in sails. You begin on the left side, sticking your needle up, then down on the right, and bring the needle up inside the first turn.

88. EYELET-HOLES.—Marline is run along the after side of the sail, and formed in bights over holes stabbed in the canvas, thus :—

89. BREADTH OF SEAMS.—An inch and a half for top-sails and courses, and an inch for top-gallant and smaller sails.

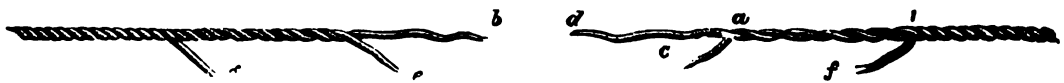
90. DISSIMILARITY IN THEIR BREADTH.—The seams of a spanker are wider at the head and foot than amidships; in a jib they widen at the foot,—the advantage of which, in either case, is not palpable.

91. MIDDLE-SEAMING.—Topsails, courses, and storm-stay-sails are alone middle-seamed.

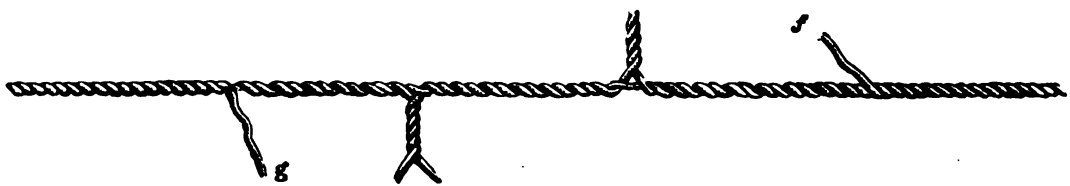
92. SICK SEAMS—Are those in which the stitches are worn, and given way here and there.

(It is to be regretted that this, and many other expressive technical terms, are gradually falling into disuse.)

lay until you come to 2, and cut another strand; unlay both to 3 (equal to the distance from 1 to 2, or thereabouts), and there cut the last strand; separate the parts and they will appear thus :—



Measure off the increased length required from 1, mark it *a*, and bring the end of the left-hand piece, *b*, down to *a*, and lay it in. The second strand, at 2, must have been cut sufficiently far from *a* to allow end enough for knotting and laying in. Twist the ends *c* and *b* up together, ready for knotting on finishing the splice, and *d* and *e* in the same manner for the present: the splice will then have the following appearance :—



Cut a piece of rope, and unlay a strand sufficiently long to fill in the vacant lay between

f and *g*, and to knot with the ends, *f*, *g*; lay the strand in, and finish off as with an ordinary long splice, from which it will only differ in appearance by its having four breaks in the rope instead of three. In putting in the long strand care must be taken to follow the lay along correctly, or it will not tally with the ends, *f*, *g*, with which it knots.

94. To shorten a Rope in the Centre.—Proceed precisely as in the previous case; but, instead of separating the strand *b* from 1,—bringing it down to *a*, *take it up* on 1 as far as you require to reduce the rope. No additional strand is used, so knot *b*, *f*; *d*, *g*; and *e*, *c*; finish off the ends, and in appearance it differs in no way from the common long splice.

95. Rigging fitted by the Dockyard.—Everything is drawn ready fitted, according to establishment, from lower rigging to a topgallant-studdingsail-halyard-block strop. Tackles and other gear are not rove, but all the blocks are stropped.

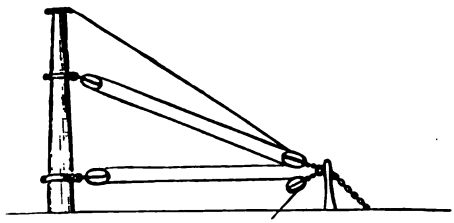
96. Fitment of Yard and Stay-tackles.—In stropping the lower blocks, a good drift should be given between the block and hook, for convenience in hooking and unhooking and slueing it; and a seizing passed below the block, and another above the thimble.

The stays should have a short strop with a thimble seized into it, rove between these seizings, to hook the yard-tackle to when necessary.

The standing part of the falls should be rove through a becket in the upper part of the block, and then slipped

e strop below the block with a running eye spliced
: end, that the standing part may be dipped when
)me in the fall.

FITMENT OF BOOM SHEET.—Two single blocks on
le of the boom, the first just outside the rail, and



)nd half-way between that and the boom-end. An
ır, on each quarter, with an eye in the end, through
s rove a chain, shackled to a bolt in the quarter,
:o short legs on the other end. To the foremost
single block is shackled, and to the after one a
block. The fall is then rove, and the standing part
into a bolt in the hoop on the boom-end.

REEVING ONE ROPE BY ANOTHER.—Put the ends
two ropes together, and worm three yarns or pieces
n-yarn between the strands for two or three inches
h side, clove-hitching the ends round the rope, or
g the strands and laying them in.

REEVING A NEW COIL OF ROPE.—Dip the end up
ı the centre, and thus a turn is taken out of every

100. LENGTH OF A COIL OF ROPE.—Hawser-laid rope, 113 fathoms; cable-laid, 101 fathoms.

101. HAWSER AND CABLE-LAID.—Hawser-laid is the ordinary three or four stranded, right or left-handed rope; cable-laid is that of which cables and hawsers are made.

102. FOUR-STRANDED ROPE—Is laid up with a *heart* in the centre.

103. RUMBOWLINE—Is coarse, soft rope, made from outside yarns, &c.; supplied to a ship fitting out, for temporary lashings, and so forth.

104. LACING OF A STAYSAIL—Is rove round and round against the lay of the stay, or the lacing would get into it and hold the sail on setting, or taking it in. After reeving, both parts of the lacing must be seized together, to prevent them tautening up and binding the sail to the stay.

The disadvantage of much lacing consists in the frequent liability of one part to get over the other, which prevents the sail hoisting or coming down; and the objection to many hanks is, that the head of the sail will not stow close down.

105. FITMENT OF STORM STAYSAIL-STAYS.—The fore stay-sail-stay is fitted with a fork, the eyes of which lay abaft the mast-head, the lower end being rove through a thimble seized into a strop on top of the bowsprit, and set up to a bolt in the stem.

Main staysail-stay is either fitted in the same manner, reeving through a thimble seized into a strop well up to

nast, to allow the foot of the sail to clear the boats, then setting up on deck; or else it is lashed on deck reeving through this strop, the end aloft rove through mp block at the mast-head, and the staysail halyard : turned into it, so that pulling upon the halyards sets ıe stay.

6. FITMENT OF STAYSAILS.—Fore and main staysails be brought to, with beckets made as follows:—Into :nd of a piece of rope splice an eye, large enough to a mathew-walker formed in the other end; and when s done, the becket should be long enough to go from eyelet-hole, round the stay, and opposite the next not binding the sail too taut to the stay. Then, ıning at the head of the sail, reeve the beckets, against ay, round the stay, and the eye put over the knot of ıext becket; and so on until all are passed,—all the s lying on one side. The halyards are double, and : through a block at the mast-head; downhaul as in r sails; tack lashed to strop round foremast or bow-

he main topmast-staysail is fitted with throat brails, tricing-line and downhaul, and sets on the spring nast-stay. The neatest way of stowing it, in ships re it is much used, is to fit a couple of catharpin-legs to after futtock shrouds, the staysail triced up, and stowed he top of them; a cover is previously laced to the most leg, which is boused up abaft, and peaked like the t of a sail; a bunt-gasket, seized to the after leg, is then sed, and the sail roused up.

The top-gallant staysail sets on the top-gallant stay, when the stay comes down to the lower cap; but, if to the topmast-head, a staysail stay must be fitted. It is taken in with a downhaul, and stows up and down the foremast-head to its own stay.

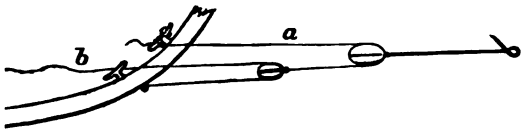
The royal staysail-stay is clenched round the main top-gallant mast-head, reeves through a clump block (which travels with a thimble seized into the strop up and down a jackstay), and thence down on deck. This jackstay is fitted with a running eye round the fore topmast-head, and sets up to the cap; a tricing-line is bent to the clump block, reeves through a block at the topmast-head, and then down on deck; the downhaul block also lashes to the strop of the clump block. The sail is set by tricing it up to the topmast-head, and then setting the stay up. When taking it in, after the sail is hauled down to the clump block, the tricing-line is lowered, and the sail and stay are hauled down to the lower cap It is then stowed up and down the lowermast-head, with the top-gallant staysail in one, covered; and the centipede passed.

A netting of small rope laced between the man-ropes on the bowsprit, is sometimes used to stow the fore topmast-staysail on; and is both neat and serviceable.

107. TOPSAIL-TYES—Are cut long, to send the yard up and down by, in addition to the sail-tackle.

108. TOPMAST STUDDING-SAIL HALYARDS.—Lead before the yard; for the sail, when set, having a forward tendency, would of course bind the halyards if rove abaft.

JIB-SHEET—leads inside the tack and outside the
e; and is best fitted, as shown in the cut, where the



; first steadied aft with the standing part, *a*, and
uled flat aft by the purchase, *b*.

LACING OF A SPANKER—Is spliced into the upper
passed round before the mast, through the next
back round the mast, and so on to the bottom. If
und and round like the lacing on the head and gaff,
d jamb when you want to trice the tack up, or
he sail down.

PEAK HALYARDS.—The advantage of the standing
ing secured to the topmast-head, consists, in the
acting pressure of the sail and weight of the gaff
the forward strain of the topsail braces, which is
y met by the mizen topmast backstays as they have
drift; but, on the other hand, an additional strain
ght on the topmast stay, when the yards are swung
ing ship.

LOWER-TACKS AND SHEETS.—Taper off towards
ling end, for convenience in handling.

SHEETS OF FORE-AND-AFT SAILS.—Should lead in
drawn direct from the centre of gravity through the

The centre of gravity of a staysail is found by bisecting any two sides of the triangle, drawing a line from these points to the opposite angles of the sail, and marking the point of intersection.

Square sails are, first, divided into triangles; then the centre of gravity of each is found, as already shown; and the centre of gravity of the sail is where a perpendicular, drawn from the centre of either the head or foot, intersects a line joining the centres of the triangles.

The centre of gravity of a trysail or spanker is at the point of intersection of two lines—one of which joins the centre of gravity of two triangles, formed by a diagonal drawn from the peak to the tack—and the other joins the centres of two similar triangles, formed by a diagonal from the neck to the clew.

114. QUARTER-BLOCKS.—The sheet is rove through the after sheeve; for, on the *lower* sail being taken in, its clew line would lead across the sheet, if rove through the foremost sheeve.

115. TOP-TACKLE FALL.—The upper block should be the swivel-block, because the turns are taken in by the pendant.

116. TOPSAIL SHEETS—Are secured with an outside clinch, that they may be clear when required to be let go.

117. TOP-GALLANT AND ROYAL SHEETS—Are bent with an eye, which goes over the toggle in the clew of the sail. The clew-line is often bent round the splice of the eye.

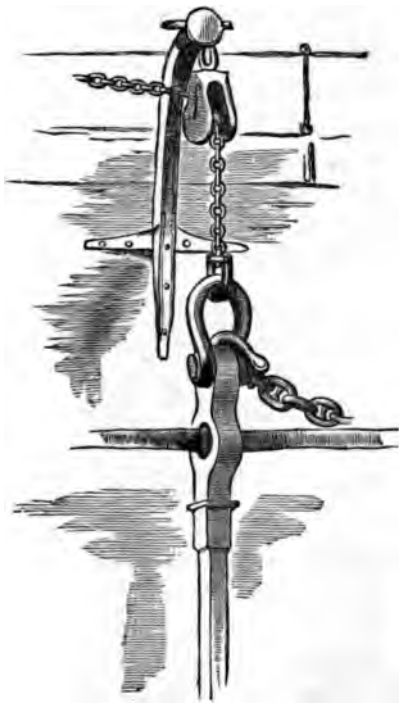
E AND MAIN-SHEETS.—The hook lies with the
)r, when the sheet hangs in a bight, the hook
:ant out, if pointed downwards.

N BUNTLINES, LEADING AFT.—Allow the
ırk round from the clewgarnets.

AND FISH-FALLS.—The cat-fall is rove
.ock on the opposite side of the deck, through
: sheeve in the cat-head ; and, when rove full,
mber-hitched round the cat-head.

all is rove
)ck lashed
· pendant,
h the lead-
the davit
when rove
/e-hitched
shank of
k, and the
l up.

-CHAIN—
hain used
ıe anchor,
a cat-fall.
of small
les to the
: anchor,
ped along
ıackle of
ıer length



reeves through an iron block at the cat-head, and before weighing, is led into the hawse-hole, in readiness for shackling to the part stopped along the cable when hove in; the cat purchase hooks to the inboard end.

122. NUMBER OF HEMPEN CABLES AND HAWSERS ON BOARD.—*See* Table XVI.

123. BLOCKS.—Reef-tackle and clew-line blocks are called *strop board;* and fore tack, *shoulder blocks.*

124. TOGGLES—Are distinguished as *round*, and *duck-bill;* the latter are also sometimes called *spring* toggles.

125. GAB-ROPE.—Rove through a block on the bowsprit cap, bent to a cringle in the foot of the jib, and placed so as to bring the foot of the sail taut along the boom; in bad weather it is the greatest possible assistance to the men engaged in stowing the sail, as it brings in the foot to them, and steadies it there while they gather up.

126. HIDING A ROPE—When the nip of a rope always comes in one place, that part must become badly chafed before the rest is much worn; to remedy this, a strip of soaked hide is worked between each strand of the rope where the nip takes, as at the yard-arm for a top-gallant sheet, or at the thimble for a main bowline.

127. SPIDER HOOP—Is a general name for any hoop round a mast, except the mast hoops,—such as those with belaying pins attached, or those for awning ridge-ropes; but the proper spider hoop is the hoop on the topmast head, through which top-gallant rigging reeves.

:8. REEF-PENDANTS OF BOOM MAINSAIL.—A mathew-er is made in one end, and the pendant rove through le in the cheek on the side of the boom, with the knot :rneath, then through the cringle in the sail, down ıgh the sheeve-hole in the cheek on the other side of ıoom; and a bowline knot, or a hitch with the end d back, is made in the end, to which the tackle is ed, and led along the boom.

8. TRIATIC STAY—Is the name given to a schooner's stay when it sets up to the foremast-head, or, else, ng through a strop abaft the mast-head, sets up on . When led straight on deck, two stays are required, veather one being pulled up, and the lee one over-ed on going about.

;o. DIFFERENT METHODS OF BUILDING BOATS.—1st. 'el-built, which have fore-and-aft planks, the edges ting, but not overlapping.

ıd. Clinker built, also of fore-and-aft planks, with the :s overlapping each other.

iagonal built, having as their name implies, their king running diagonally, the inside planks running in ntrary direction to the outside ones, and their edges ting.

31. TECHNICAL PHRASES.—When a buoy leaks, it re-es to be *bled* occasionally to let the water out, and is ı plugged up again.

A buoy *watches*, while it maintains its position above

water and is not borne under by the strength of the tide or any other cause.

A cable *grows* in the direction it leads from the hawse-hole. Ahead—on the bow—or under foot, as the case may be.

When, from the fall of the tide, the water leaves a ship that is aground, the ship is said to have *sewed* so many feet or inches as the tide has fallen below her original water-line. The word *sewer* (drain), has the same derivation.

A mast is stowed *abaft* when it is stowed athwartships.

132. Shot and Grape Canister—Should be stowed with the grape and canister at hand to each other.

133. Wide Ports.—The great objection to their width is, that it lessens the efficiency of your guns by diminishing the range of training.

134. Largest Rope and strongest Rigging.—The fore and mainmast shrouds, which reeve double, are the longest ropes, and the forestays, mainstays, and lower rigging are respectively the strongest pieces of rigging.

135. Largest Planks.—Treble and four-fold 30-inch.

136. Splicing a Three- and Four-stranded Rope together.—For a short splice, divide the fourth strand into three parts, and lay one part in with each of the three

nds. In a long splice, work three strands in as usual; , when finished, put the fourth strand in where it lies.

37. SPLICING A HAWSER.—Work a long splice, as with awser-laid rope, but, instead of knotting the strands, ay them, marry them together, and tuck them in under strand that you would reeve them through if you had tted them in the usual manner; under this first strand he hawser put all three strands of the strand; under the t two only, then one, and, lastly, *back* this one.

Long-splicing the strands can only be done with old, soft sers, which are not worth the trouble, and for these a oud-knot, with the ends marled down, and served over, he best treatment.

138. SPLICING A THIMBLE INTO A LARGE ROPE.—After e half of each strand is put through, it is cut off; and e other half is opened out, wormed along between the nds and marled down.

139. ANCHOR-STROPS, &c.—Put the ends in *twice*, don't t them off close, but *whip them.*

140. CUTTING OFF ENDS OF LOWER RIGGING—If in he chains and hemp, saw them off; but, if you have got he rigging inboard, turning it in afresh on a platform of two or three water-casks up-ended, which is the best way, ay the end on the edge of an axe resting on a block of wood, and strike down on the rope with a commander; wire rigging stretches so little, that it will rarely require cutting.

[illegible] YARN.—Red, Plymouth; blue, Portsmouth [illegible]

[illegible] STRENGTH OF A YARN.—In round numbers you [illegible] lbs. for the average strength of each yarn, [illegible] is found to be greatest in the smaller [illegible] for 12-inch rope, the mean average strength is [illegible] for 9-inch, 78·4 lbs.; for 1½-inch, [illegible] lbs.; for 3-inch, 104·5 lbs.*

[illegible] ULTIMATE STRENGTH OF ROPE OF DIFFEREST [illegible] three parts of [illegible] number of yarns in, and therefore the [illegible] different sizes, varies with their [illegible] are proportional to the [illegible] it follows that.—

[illegible]

[illegible] parts of the small rope [illegible] the larger rope, then

[illegible]

[illegible] parts of a small rope are equal to a larger rope [illegible] allowing for the difference of the [illegible] as shown above, affects the strength of the rope—while the square of the circum-

* For [illegible] the properties of rope [illegible] Tinmouth's [illegible]

ference of the larger rope by the square of the circumference of the smaller, and the quotient will be the number of parts of the smaller equal to the larger.

144. PRACTICAL RULE FOR ASCERTAINING THE STRENGTH OF ROPE.—The square of half the circumference gives the breaking strain of the weakest hawser-laid rope in tons, and is, therefore, a safe rule. For instance :—

1. *By experiment*, 4-inch rope breaks at a maximum of 5·3 tons, and at a minimum of 4 tons.

By rule, $\left(\frac{4}{2}\right)^2 = 4$ tons.

2. *By experiment*, 6-inch rope breaks at a maximum of 11·75 tons, and minimum 8·7 tons.

By rule, $\left(\frac{6}{2}\right)^2 = 9$ tons.

3. *By experiment*, 10-inch rope breaks at a maximum of 31·7 tons, and minimum 24·2 tons.

By rule, $\left(\frac{10}{2}\right)^2 = 25$ tons.

RULE FOR CALCULATING THE WEIGHT OF ROPE.—Three-strand, hawser-laid, 25-thread yarn, tarred. Multiply the square of the circumference by the length in fathoms, and divide by 4·24 for the weight in lbs.

Ex. 1. 2-in. rope, 113 fms. $\frac{2^2 \times 113}{4{\cdot}24} = 106$ lbs. Actual weight 105 lbs.

„ 2. 4-in. „ „ $\frac{4^2 \times 113}{4{\cdot}24} = 428$ lbs. „ „ 424 lbs.

„ 3. 12-in. „ „ $\frac{12^2 \times 113}{4{\cdot}24} = 3837$ lbs. „ „ 3840 lbs.

The divisor for hempen cables is 4·79.

Ex. 1. 10-in. hawser, 100 fms. $\frac{10^2 \times 100}{4{\cdot}79} = 2088$lbs. Actual wgt. 2088 lbs.

„ 2. 20-in. cable „ $\frac{20^2 \times 100}{4{\cdot}79} = 8351$ lbs. „ 8352 lbs.

„ 3. 26-in. „ „ $\frac{26^2 \times 100}{4{\cdot}79} = 14113$ lbs. „ 14112 lbs.

Chain cables are about 2·3 heavier than hempen cables of the corresponding size.

145. HAWSER-LAID ROPE—Is stronger than cable-laid, in the proportion of 8·7 to 6.

146. CABLE-LAID ROPE—Is so laid up to exclude the water.

147. PRACTICAL RULE FOR DETERMINING THE RELATIVE STRENGTH OF CHAIN AND ROPE.—Consider the proportionate strength of a chain and rope to be ten to one,—using the diameter of the chain, and the circumference of the rope. Half-inch chain may, therefore, replace five-inch rope.

The absolute strength of chain, at the *breaking point*, may be found by dividing the square of the diameter in eighths, by 2·4, for round-linked crane chain; and by 2·7, for chain cable.

Ex. 1. 1½-inch round-link chain.

By experiment, minimum, 58·2 tons; mean, 62·3 tons.

By calculation, 144 ÷ 2·4 = 60 tons.

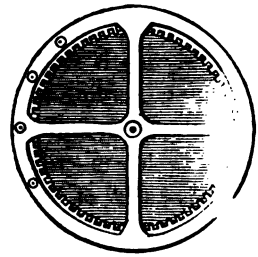
Ex. 2. ½-inch; minimum strength, by experiment, 6·9 tons.

ulation, 16 ÷ 2·4 = 6·7 tons.
2-inch cable; minimum strength by experiment,
ulation, 256 ÷ 2·7 = 94·2 tons.
½-inch: minimum strength by experiment, 5·9

ulation, 16 ÷ 2·7 = 5·9 tons.

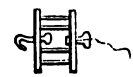
TRONGEST DESCRIPTION OF HEMP ROPE—Is white, three-strauded rope; and the next in the rength is the common three-strand, hawser-laid ed.

SE OF THE ROPEMAKER'S WINCH.—A ship's ich will make very fair e, is about 15 inches in



In the frame, which , are placed five hooks e upper ones for gene- the fourth for four- rope, and the centre ardening up large rope as been laid up by the upper ones (the la ter sufficiently strong for that purpose). The sha ks oks, between the two parts of the frame, re n cogged barrels, which are turned by the wl l, ation of which gives nine to the hooks—any ne an be thrown out of gear by hauling it back he after part of the frame.

is a swivel-hook, which, by revolv- , allows the strands to twine up to- r the twist put in them as the top is withdrawn.



The *top* is a conical piece of wood, scored on the outside for the reception of the strands. Its use is to keep the strands separate between it and the winch, and to regulate the amount of twist in the rope behind it, by being moved along either slowly or rapidly. When four-stranded rope is required, a hole is bored through the centre, as a lead for the heart.

A length of junk being brought on deck, you proceed to unlay it by attaching the strands to separate hooks, and the layer to the other end—one hand holding back on it, and then heaving back—two hands following the rope [illegible] to separate the ends.

Spunyarn is made by hooking all the yarns that compose it (according to the size required), upon one hook. You then heave round the reverse way to the lay of the yarns (which in ordinary rope are all right-handed), until there is plenty of back turn in them, holding on the ends by hand; then rub down, and make it up.

In rubbing down, a boy puts the end of a strand over his shoulder, and walks away with it, another hand holding on the rubber (which is the end of the strand doubled up loose), round the stuff they are laying up.

As many lengths of spun-yarn can, of course, be made at once as there are hooks on the winch.

Marline.—Hitch the yarns to separate hooks; let a couple of hands then take hold of them, and commencing close to the winch, walk back while it is hove round the reverse way; the yarns are thus hove up the contrary way

what they were originally, to soften them; for, when wn out of rope, they are usually hard and angular, and ld not lie square, or bear an equal strain, if laid up in t condition. When thus relaid, the ends are knotted ether, the loper hooked on—one hand holding on to it, top put in, the winch hove round the same way as at t, and the top moved along towards the winch. When to it, the top is taken out, the yarns unhooked, and ched to a single hook, then the winch hove round the posite way to what you have just been heaving it, to den the stuff up, rubbed down, and made up.

Thus, the yarns will be left-handed, and the nettle-stuff ht-handed; for, though the winch is hove round the me way with both, the twist in the yarns causes them to ke abaft the top with the lay of the contrary denomina-n, and the revolutions of the loper prevents the turn ming out again.

Six (or nine) thread stuff.—Put two (or three) yarns on ree separate hooks; hold on the ends by hand, keeping ch of the three lengths separate, and heave round a verse turn, as with spun-yarn. When sufficiently hove , knot the ends together, hook on the loper, put in the p, and proceed as with nettle-stuff.

Cable-nippers are laid up the same way.

Hammock lashings are made of three strands of three or ur-yarn nettle-stuff, hove round the reverse way, which rns cable-laid stuff, left-handed.

150. THREE-STRANDED ROPE—Is one-fifth stronger than ur-stranded.

151. A SPLICE—Weakens a rope about one-eighth.

For the comparative and actual strength of chain cable wire and hemp rope, see Tables I, II, III, IV, and V., the end of the book.

152. A ROPEMAKER'S EYE—Is used for forming collars of stays. The stay, four-stranded, is unlaid, strands each way; then each half is doubled back, and up with its own part. At the fork the four strands worked in, as in splicing, tapering off by thinning strands each time they are put in. The eyes and fork then served over.

153. BUNTING.—At regular intervals, six or seven thre together are worked in of much larger size than the oth

154. CANVAS.—Each cloth is marked with a thin wav line of blue paint, being run up and down it.

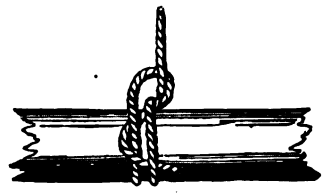
155. ELLIOTT'S EYE.—Put a whipping on the cable couple of fathoms from the end, and unlay to it. Spli two strands together with a long splice, making the e thereby formed equal in length to the diameter of t thimble and the breadth of the seizing; and splice t third strand to its own part, making an eye-splice equal the eye already formed. Place them together, fid the out, put a piece of rope between them to fill up the hollo and hitch the eye over with small rope. Seize the thimb in with a round seizing of inch-and-a-half, and heave on kackling of two-and-a-half-inch rope, two fathoms dow from the eye.

IOTTING AND SPLICING.—The important items of cal seamanship here enumerated can only be properly t by practical demonstration, and I therefore, in this ıce, feel disposed to vacate in favour of the boat-, and to recommend my "young gentlemen" readers their marling-spikes assiduously on those Saturday oons so considerately set apart in most ships for purpose. However, for the benefit of those who ıt, perhaps, avail themselves of the boatswain's ınce, I subjoin a description of all that is of any cal use, omitting that which is either merely fanciful solete.

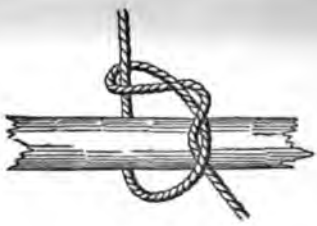
6. SHEET-BEND.

157. CARRICK-BEND.

8. STUDDING-SAIL).—Two round turns l the yard, then a itch round the stand-part and under both , and the end tucked tween them.

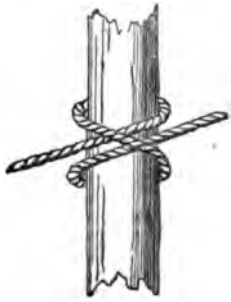


159. ROLLING HITCH.—A rolling hitch is that used for stoppering a rope. It is formed by taking a hitch with the stopper round the rope, then taking another hitch above the first and between the stopper and the rope, and then dogging the tail *back* round the rope *with the lay*.



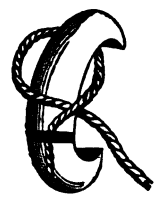
160. TIMBER HITCH.

161. BLACKWALL HITCH.



162. CLOVE HITCH.

ıg-bolt is usually hitched over with either two
s. With two ends,—after seizing or hitching
are not working on, to the ring-bolt, you com-
cing a left-handed hitch with

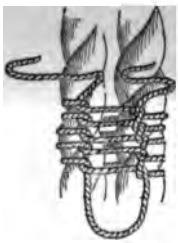


ails, keeping the cross on the
bolt, which brings the end
ht ; you then double this end
own part to the left, bring up
over this, take a hitch as with
double it back, bring up the
so go on, taking alternate hitches with each,
the end out to the right with each hitch.

ends,—you begin by taking a

ıitch with the first leg, a
hitch with the second, then
with third, right-handed with
cond,—right, third,—and so
h being passed in the oppo-
he preceding one—two ends and one end
ng on each side. The ends are finished off
hem down, and either
hipping, or working a
round them. When
t has the appearance
cut.

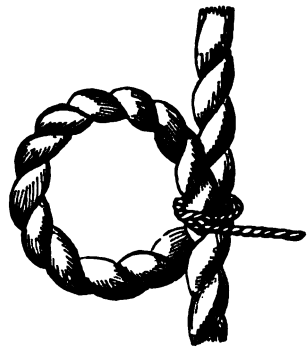
164. A COMMON MARLING HITCH.—It that used for lashing a hammock up, and is simply thus :—



A Marling Hitch for davit-head blocks (fish), &c., is formed by middling the marline, laying the bight along the top, in the centre, and securing it there; then dipping the right-hand end underneath and taking a turn under, and round the left; bringing the left up, and taking a hitch over, and through the bight of the right-hand end; heaving the turns on taut, and keeping them square.

165. KACKLING THE EYE OF A STREAM CABLE.—Secure one end between the parts of the eye, and work on the other end by taking a hitch, alternately right-handed and left-handed, till the eye is covered.

ıund Seizing.—Splice an eye
ing, pass it under both parts of
and reeve the end through the
k up, lay hold of the upper
end part with your left hand,
er turn with your right, and
seizing round left-handed un-
h turns—six, eight, or ten—
l round; then reeve the end
ween the upper and under
l bring it up through the eye;
re each turn taut separately,
he eye on the left-hand side.
ı have hauled the end taut
ıe eye, pass the riding turns
the same direction as at first,
mber less than the inner turns,
ed hand-taut. When all on,
end down between the two
of the upper side of the inner
ween both parts of the rope,
:wo round turns, crossing all
ıe seizing; then slue the rope
finish off with a reef-knot on
side, as in the figure.



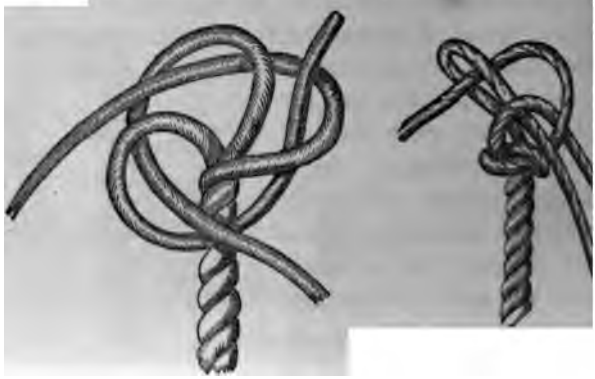
167. THROAT SEIZING.—The old throat seizing, used when rigging was turned in with end up, is now seldom required except in seizing a thimble into one of the smaller stays. The end of the rope being laid over the standing part, the seizing is passed, precisely as a round seizing, until you have passed the end down between the two last parts of the inner turns, when, instead of passing the crossing turns right round, you reeve the end between the upper and under turns of the seizing, bringing it out alongside the eye, and so only pass the crossing turns over the upper half, finishing off with the reef-knot on the top of the seizing. Then, when the end of the rope is seized up to the standing part, it will be seen from the tautness of the underneath parts of the seizing, occasioned by the end and standing part of the rope being brought together, that the tension on the crossing turns would be too great if they were passed round all.

. RACKING SEIZING.—The first turn is passed round parts of the rope like a round seizing; it is then l between both parts, and the the remaining turns ssed as racking turns—over nder. When the requisite er are on, reeve the end inside the last turn, bring it tside, and pass the outside back towards the eye of the g, allowing them to sink in en the parts of the first ; by which it assumes the rance of a flat seizing, as are in reality no *riding* turns. When down to the lip the end down between the two first turns, and off with a reef-knot.

). A FLAT SEIZING—Is commenced the same as a l seizing, but on the end being rove through the eye, inished off at once with a reef-knot without any riding .

o. SHROUD KNOT.—Open out the ends of the rope are to be knotted, put them together as for splicing, single wall the strands of eaeh end round the main of the opposite end ; then taper the strands off, marl n, and serve over.

171. SINGLE WALL. 172. WALL AND CROW

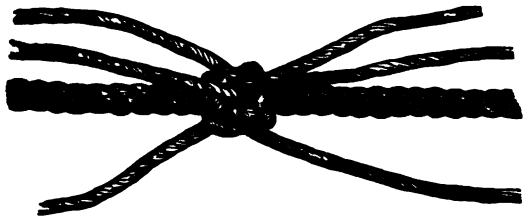


You may now double wall and double crown, by letti the strands follow their own parts round; first doul walling and then double crowning, and cutting the ends

173. DOUBLE WALL AND DOUB CROWN.

174 FRENCH SHROUD KNOT.—Crown backwards, le handed, the strands of each end; then dip the ends th

rom you to the left of those that fall down *towards* ; haul them into their places, and you will find that will accommodate themselves to the knot better in way, than if they were allowed to remain as they came The knot will then appear thus :—



hen tuck the ends in as in splicing (which you can do, with the common shroud knot), or tease the strands nd marl down.

5. MATTHEW WALKER.—Put a whipping on (as with nots), open the strands down to the whipping, and pass the first end through its own bight, the next through its own and the first, and the third through all three bights; haul the ends through, work the turns round and place them; the knot will appear as in left-hand figure.

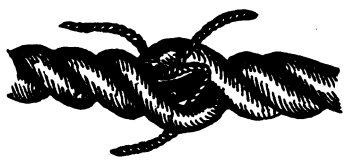
176. TURK'S HEAD.—Take two round turns round the rope, pass the upper bight down through the lower, and reeve the upper end down through it; then pass the bight up again, and reeve the end over the lower bight and up between it and the upper one; dip the upper down

through the lower bight again, reeve the end down over what is now the upper bight, and between it and the lower; and so proceed,—working round to your right until you meet the other end, when you pass through the same bight,

and follow the other end round and round until you have completed a plait of two, three, or more lays, as you wish. The right-hand cut shows a Turk's head of two lays.

177. TURK'S HEAD WORKED INTO A ROPE.—This is done when the knot has to resist a strain, as the rung of a Jacob's ladder. You middle the marline or nettle-stuff that you are working with, and splice a second piece into the centre so as to form a third leg; then pass an end through the rope, and haul it through to the junction of

the third leg, which reeve through the third strand of the rope, bringing an end out between each strand.



Then crown the ends round the [illegible], left-handed; slue round, and down them back, right-handed, and the knot will appear as in the figure. Follow each part round with its own end, cut the ends off, and it will be undistinguishable from the common Turk's head. With four-stranded rope, you use four ends.

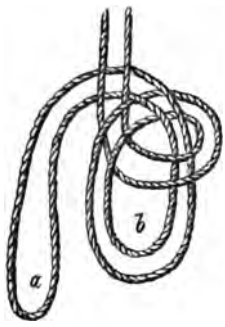
178. Reef Knot.

179. Stopper Knot.—Double wall, lay the ends up, put a whipping on, and cut them off.

180. BOWLINE KNOT.

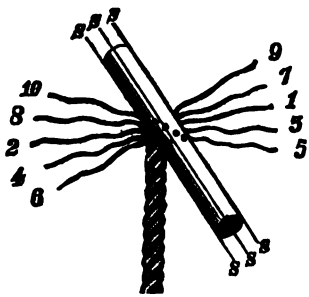
181. RUNNING BOWLINE.

182. BOWLINE ON A BIGHT.—The bight *a* being passed over *b*, forms the knot *c*.



183. FLEMISH EYE.—Put a whipping round the rope, open the strands out down to it, leave out the outside

rns and stop them back, and make the rest up into foxes. alve them, and put a round piece of wood, the size of e eye required, between em on the top, with three ops laid along it, *S*, *S*, *S*. not the centre foxes of ch side, 1 and 2, on *the* p of the spar, and knot 3 d 8 from you, with a knot little round to the left. hen when all on that side

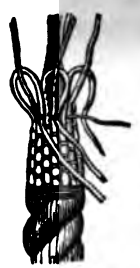


f the centre fox are expended, commence on the other ide, and knot 7 and 4 a little round to the right, towards ou, and 9 and 10 more round, and so on. When all are notted, tie the stops together, to keep the eye from lling adrift, and take the spar out; put a seizing round he foxes close to the shoulder of the eye, and then cut hem off. Bring the outside yarns over from each side, acing them in the hollows to round the eye off; tease he ends out, and worm them in between the strands at he shoulder. Then marl all down, fid the eye out, arcel, and spike-serve it. When neatness is an object, uft the eye over with nettles made of two outside yarns.

184. A Fox—is made by rolling a couple of yarns up he contrary way on your knee, and then rubbing them own.

A Spanish Fox—is a single yarn rolled up the reverse ay, and rubbed down.

185. POINTING A ROPE.—Put a whipping on, open out the strands down to it, and form the heart of the inside yarns, tapered off, and marled down hard. Having left out the outside yarns, and laid them up into two-yarn nettles if the rope is not very small, tell them off, one up and one down alternately; knot the filling with a timber-hitch over the upper ones, pass two turns, and dip the end between both to jamb it before hauling the last turn taut; then bring the upper nettles down, and lay the lower ones up, pass the filling, and so proceed, hauling the nettles taut up after each round, and passing the first turn of the filling under one or two of the upper ends in advance, each time, instead of over them; which allows the lower nettles to hide the hitch when brought up. To finish off, secure the lower nettles with the filling, as shown in the figure. Cut the upper ones off as they are, and the lower ones when you have passed two turns of the filling, hitched it and hauled the bight of the nettles close down.



With large ropes, you secure the upper nettles as well, by taking a hitch with the lower ones round the upper ones and the filling thus :—

Grafting,—in which the rope or strop is covered the entire length, and not at the end only, as in pointing, is performed in exactly the same manner, with nettles laid along it.

6. POINTING A LARGE HAWSER.—Clap on a whipping ree-yarn nettle-stuff, snaked. Open out the strands, he heart up three-stranded, and splice a becket into hich has previously been eye-spliced into its own part. the outside yarns up into five-yarn sennit; use, for g, a two-yarn fox; and continue as already shown.

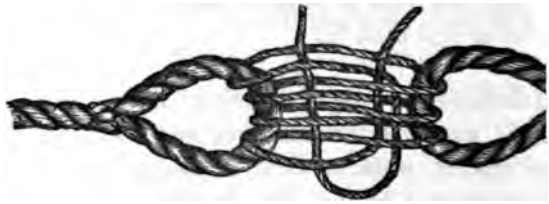
7. CROSS POINTING.—Commence as for straight ting and, having laid the nettles, one up and one alternately, bring an upper nettle down to the *right* corresponding lower one, lay the lower one up, and in this way once round to the right; commence again, and bring what are now the upper ones down to the *left* of the lower nettles, lay the lower ones up, and so work round backwards; then, bring them down again to the right, and so go on. Finish off with two turns of straight pointing, as in right-hand fig.

8. HITCHING—Is a very convenient method for ring boats' awning stanchions, &c., and doubtless, r of my readers, when attached to landing parties, availed themselves of serviceable-looking soda-water es, slung and protected in the same manner. The es to be used are middled, laid along the article to be red, and secured in their places with a turn of filling. rking from one end, as in the cut, all the nettles are up: if working from the centre towards the ends,

the nettles on each side of the filling supply the
The turn of filling being passed and hitched as
commence hitching the nettles round the filli

each taut separately, working
keeping the filling taut, and
and round. If what you a
contracts in circumference,
leave out a nettle occasional
it off; and, should it increas
ones in. It is finished off
the bights of the last round
you have passed a couple of turns of the filling
it as in finishing off pointing, when in the sa
haul the bights close down, and cut the ends o

189. ROSE LASHING.—Reeve through the
lashed, middle it, and pass racking turns, leav
the ends in the same bights; pass each end b
bights of the lashing on either side of the crossin



in the cut. Then take two or three round tu
them opposite ways, haul them well taut, and kn

190. A NETTLE—Is made of two or three ya
with finger and thumb, keeping the lay in the
left-handed stuff.

Thumb Line—Is made of yarn twisted up the reverse way, and is right-handed.

191. WHIPPING A ROPE—In the ordinary manner, is done by laying the end in the lay of the rope, pointing upwards the end, passing a few turns round the rope, binding the end of the whipping; then laying the other end on the turns already passed, pointing downwards, passing the remainder on the bight, round the rope and the last end part, hauling through on the end part, and cutting off.

A West-country Whipping—Is that used for putting a mark on the fore brace, for instance; and is done by middling the whipping, and half-knotting the ends on each turn, on opposites sides of the rope; and finishes by knotting the last turn with a reef-knot.

A Sailmaker's Whipping—Is put on with needle and twine. A reef-point has always two such whippings on the end. It is first stuck through with the needle, the twine is drawn to the end, several round turns are passed, the reef-point is stuck through at each end of the whipping, and two crossing turns are passed; then secured with two half-hitches round the upper part of the crossing turns, and hauled close down.

Crowning the End of a Rope—Is a rough substitute for whipping; and the strands are then tucked in twice or thrice, as in splicing. Lead lines are generally served in this way.

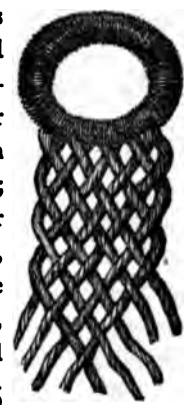
192. A GRUMMET.—Take a strand, three times the round of the grummet required, with end enough in addition for tucking in for finishing; middle it, lay the right-hand end over the left, and follow the lay round with each end until the rope is re-formed; then tuck the ends in where they meet, as in splicing.

193. A SELVAGE STROP—Is made of spun-yarn, or small rope, according to the size required, warped off, and marled down.

194. COMMON SENNIT—Is made with an odd number of nettles. If, however, an eye is to be formed, you commence with an even number—one being a short one; and after the eye is formed, the short end is worked in, or, if too long, left out and cut off,—leaving an odd number to go on with. We will suppose that a reef-point is to be made of seven parts of spun-yarn:—Cut off four lengths (one being but little more than half the length of the others), middle them, toggle the bights through a becket triced up before you, halve the nettles, lay the right-hand nettle over the next one to it, bringing it over to the left, making three now on your left, and one on your right; bring the outside nettle on the left over two, which will equalize them again; then the right over one, left over two, and so on alternately till you have worked length enough for the eye; next bring all eight parts together, halve them

on as at first—right over three, and left over four. wo or three lays are worked in this way, leave out rt end, and continue with seven parts,—right over three, and left over three in succession. Finish off by forming a bight of the left-hand nettle when you bring it over, laying the end up; and as you work the remaining nettles in, point them down through this bight; and, when all are in, secure them in their places by hauling the bight taut through upon them and cutting the ends off, as in the left-hand fig.

FRENCH SENNIT—Like common sennit, is made odd number of nettles. If about to make a har-sket for a royal yard in this manner, of nine parts le-stuff, cut off five lengths (one being a short one), them, put a seizing round the bights the eye, which marl down, and ver; then bring all nine parts to-(having left out the short one after zing was passed), and divide them e to the right, and four to the left; he outside one on the right, over der the nettles on its own side, g it out to the left, then do the vith the outside nettle on the left, it out to the right, when there will

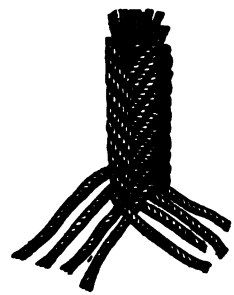


be again five on the right, and four on the left, and so continue the mat in the same manner.

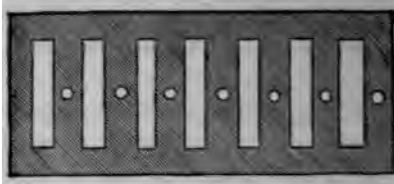
196. ROUND SENNIT—Is used for man-ropes, yoke-lines, &c. Stretch a heart of small rope taut along between two belaying pins, or other convenient fixture; take 8 (12, 16, or more) nettles, put the whipping round the heart and ends, to hold them, divide them into fours of 2 (3, 4, or more) parts each; then lay No. 1 pair over the heart, to your left; then No. 2 to your right, crossing the 1st pair; next No. 3 pair under all to the right, and over No. 2; No. 4 round under all to the left, and over No 3. Then No. 1 round to the right, under 2, and over, 4, 2 round to the left, under 3, and over 1; and so on, always bringing the upper pair on the opposite side, to cross over the pair last passed. Finish the end off by pointing the heart with the nettles made into smaller ones; and finish the top by walling and crowning the heart, covering it with duck to round it, then double-walling and crowning the nettles over the heart knot, previously whipped underneath, with a Turk's head to cover the whipping. Or, after forming the knot of the heart, and covering it, and putting the whipping round the nettles underneath, you may cut them off, and cover the knot with Turk's heading of mackerel line, begun very slack,

l spread over the knot, by passing with a sail needle, as ny lays in the plat as will be required to cover the knot.

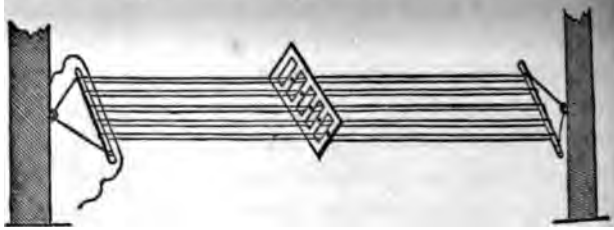
97. SQUARE SENNIT—Is used for the same purposes ound sennit, and also by engineers, as packing for their ons. It is made somewhat in the same manner as nd sennit but without a heart. Nettles are used in the e ratio, increasing by fours, but are worked singly in- d of in pairs. Having put a whipping round the ht) ends, divide the nettles, and lay half on each side: g the uppermost left-hand nettle round underneath all, l up inside two, of the right-hand ones—crossing over latter ones to the left, and making four on each side in; then take the uppermost of the right-hand nettles, s it underneath, and under two l over two of the left-hand ones—l keeping four on a side, because : nettle taken up always comes nd to its own side again. To ceed, take the upper nettle on ch side alternately, and finish off you finish round sennit.



198. SWORD MAT.—At a distance apart, equal to the ngth of the mat, sling a couple of bars in a horizontal sition. Hitch one end of the warp to the bar at the nd on which you intend to terminate the mat; take up he loom, which is made of a sheet of copper perforated ith holes and slits alternately, reeve the other end through



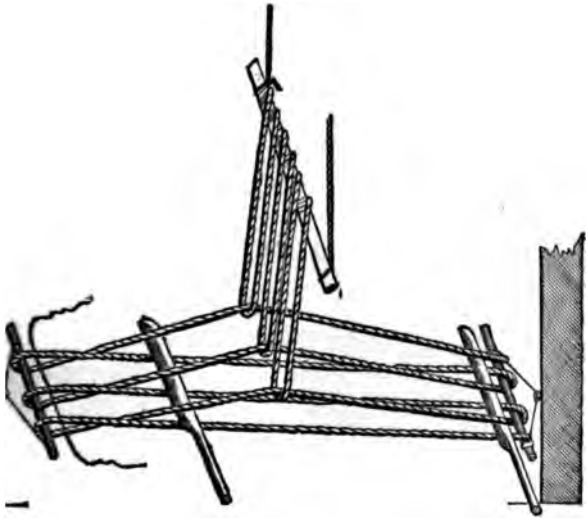
the first hole, over and under the bar at which you intend to begin, back through the first slit, under and over the other bar; and so wind off as many parts as are required for the breadth of the mat, the last turn being rove through a slit, and secured to the bar, at which you finish off. This done, lift the loom up, middle the filling, and lay it between the upper and under parts; then lower the loom,



and the parts that were lowermost will rise in the slits, become the uppermost, and thus put a cross in the warp. Next put the sword, made of hard wood in the shape of a knife, in between the upper and under parts, and drive the crossing close up towards the bar, and harden it well up; then pass a turn of filling to secure the crossing, reeving the ends through contrary ways, haul it taut, take out the sword, lift the loom up, and go on again. When you come to the last turn of filling half knot it with two turns.

If you have to make a mat for which your loom is not

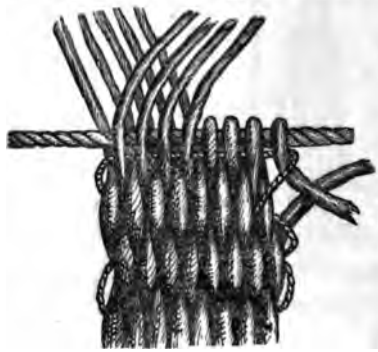
enough, you rig a fiddle, by slinging a handspike
rtships to the main deck beams overhead; pick up
other part of the warp, and, with a piece of nettle-
passed over the handspike with *two round turns*, and
round the alternate parts of the mat, trice them up.
pper parts will thus cross the under parts before and
the fiddle, and you will require two swords. Reeve
illing, and secure the first crossing already formed,
e parts being triced up, in the ordinary manner,
ning it up with the first sword; now, put the second
d in between the crossing and the bar abaft the fiddle,
the mat a shake to disengage the parts, and with the
d lift the upper ones up; the crossing will thus be
ded before the fiddle, so withdraw the first sword,



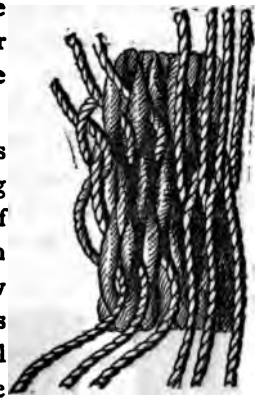
put it in abaft this crossing, drive it up and secure it with a turn of filling; again lift up the fiddle, keeping the second sword fast (which is never removed); a crossing is again formed at each end; and you again repeat the operation.

With a heavy boom-mat five or six feet wide, you require a second fiddle underneath, to rouse the parts through. A couple of hands jump down on the handspike; and the upper one, which is triced up by a couple of jiggers, is lowered at the same time.

To finish off or *selvage* the mat:—After passing the last turn of filling, and securing it with a half-hitch with two turns, you lay the lanyard across on the top of the filling, and commence unreeving again the front row of nettles, one at a time, beginning on the right. As you withdraw them you bring the corresponding nettle, at the back, over the lanyard, and filling, and reeve it back through the hole left vacant by the one hauled out, thus: go right across, and haul the bights taut down to the lanyard. On slueing the mat round, you will find that this will leave the second row of filling bare; so go on withdrawing the same ends again along the second row, and pointing the same reeving ends



first, through the holes the others came out of, ng the filling and complete four or five rows of this : same manner. Then, to cover the last row of and to secure the ends of the nettles, you lay them d down alternately, the long ends that you have awn going up, and the short ones that you have eeving, laying down; haul them taut, beat them in, en tuck them under the bights of the next lay, the ones left-handed through the to the right, and the upper nded to the left. Beat the)wn and cut the ends off.



'o finish off by *shouldering*, as : upper part of a lower rigging rhen, after reaching the top of lead-eye it is contracted in to cover the shroud for a few), you leave as many nettles each edge of the mat as will : it sufficiently, then lay the d (to secure the mat above the dead-eye) along the the last turn of filling, and go on working on the nettles that you have retained, as far up as you to go. Knot the filling, tease the ends of the out a bit, place them round the shroud and serve)ver. The ends that you left out, on each side, you off by selvaging, as already explained. As the ; stretches, turn the bottom of the mat up, with the side.

199. SPLICING A SWORD MAT.—Unlay six or eight of each mat, open the ends out, marry them togeth ing one up and one down flat along the mat, withdı nettles on one side of one (No. 1) mat, and po nettles of the other mat (No. 2) through the hol come out of; all ends will then disappear from th and there will be four rows of ends on the other over, pick out the proper nettles of the side, whic been married together, withdraw the ends belon No. 2 mat, and introduce the corresponding ends o through the holes. The same operation has no performed on each mat, and on each side there two rows of ends; marry those together on each si ing one up and one down, and go on splicing by wi ing and reeving, for two or three rows more in ea Leave off with the ends all out on the same sic finish off as with selvaging.

A Cobbler's Stitch—for joining the sides together. Take a f roping twine, middle reeve each end thro bights in each ma heavy mat, throug bights at each edg reeve the lowermost end back through the same b the upper end, which will bring the ends out at sides; draw the mats together, and reeve bo through two turns in each mat again, passing ea

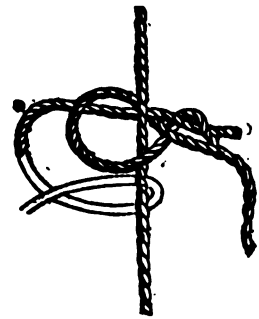
through the same hole opposite ways; and so work on, like a cobbler stitching a sole. Finish off each end, by taking a hitch through a bight in the mat of the next lay above, and cut the ends off.

200. PAUNCH MAT.—For heavy rigging mats, strands of 3-in. or 3½-in. rounding would be used for foxes, with a lanyard of 2½-in. Stretch the lanyard along at a convenient working height, middle the foxes and lay them across it, and, commencing on the left, lay up one turn in the first pair, right-handed. Repeat this with the second pair, and lay up the nettle that comes round to the front and left, one turn with the underneath nettle of the first pair, which was brought out to the right; then lay this latter up, one turn with the other nettle of its own pair, and take a hitch with it,—which do with the two last nettles on the left, each time that you work down to them, to keep the mat from unlaying again. Now commence with the third pair,—take the underneath nettle round the upper one, which lay up with the underneath and right-hand nettle of the second pair, which lay up with the other one of the second pair, which lay up with the under one of the first pair, which lay up with the left-hand nettle of all, which lay up with two or three turns to prevent unlaying, round which take a hitch. So proceed until all the nettles are brought in,—a second hand holding them back as you lay up, and when you have come to the last, and the full breadth of the mat is formed, go on in the same way, working down for length. When you have obtained this on the left edge of the mat, it will appear as

in the figure; and you then begin to work down sp
taking a hitch with each pair as you have finished
them, to prevent them unlaying.

To selvage it, take it down, and lay it on a
commence with the first left-hand fox, which brin
under the next one, and lay up along the mat, la

hat it comes round (which is the second fox) down-
s, and in this manner go right across; then stretch
anyard along the nettles where they cross, and hitch
nds to the grating. With the first fox laid upwards
a right-handed hitch round the lanyard and the first
down, then take the down
a, dip it back under the
ird and haul it taut down,
her hand at the same time
ing back on the upper one
so knot the foxes right across.
n done, haul all the lower
s taut up, and, beginning on
left, cross the upper nettle
ich is on the left of the lower)



: it, and reeve it through the bight in the mat in the
iediate lay to the right, bringing the end out to the
: (rove left-handed.) Beat the hitches down, and cut
ends off, but not close; for if left of the proper length,
will form two rows of thrums. Tuck a thrum in every
d bight up, and in every other lay across, which is
e thick enough; and beat down the bights in the mat
t they are rove through, each time separately.

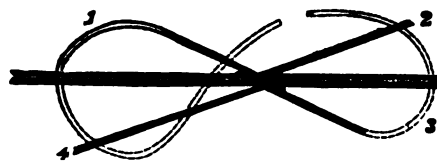
To make a Breeches Mat.—Mats of this shape are used
the collars of stays; the broad part lying over the
tch, and the legs lacing round each fork. You work
mat down square as far as you require it, then halve
foxes, and work each part down separately for the
s.

You may convert an ordinary mat into a breeches mat by cutting the midship fox across at the head, and simply unreeving it down as far as is wanted; then crossing the ends, and tucking them into adjoining bights.

To repair a Rigging Mat—That has had a hole chafed through it. Stick sufficient foxes through the bights of the mat at the top of the hole, to cover it, lying well over the edges, and back clear of the hole, and middle them. Bring the left-hand fox round the next one to it, lay its end up, and the one it comes round downwards, like the commencement of selvaging; go right across and secure it by sticking the left-hand nettle, right-handed, through a bight in the mat in the edge of the hole, and the right-hand nettle, left-handed, through a similar bight, the ends of each pointing outwards; then work the next and succeeding rows as a paunch mat is worked, but working square across, laying one fox up with its next only, and securing each row as it is completed, by tucking the right, and left-hand nettles in as you did with the first row. When you have thus covered the hole, stick all the ends through the bights below them left-handed once or twice, and cut them off; then slue the mat over, and either stick the broken ends into the new piece, or bring the edges together with a lacing,

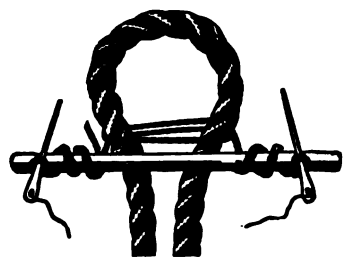
201. DRAWING AND KNOTTING YARNS.—Having taken the twist out of the strand, let a couple of hands lay hold of the ends, and beat it on the deck to loosen the yarns, which

then drawn
. They are
tted toge-
; for rope-
ing purpo-
by splitting



ends, scraping them down, and marrying the forks ther. No. 1 end is then brought underneath towards and half-knotted to No. 3 end, which is passed rneath, from you, giving it somewhat the appearance reef knot; then tauten it to jamb the knot, and cut ends off.

92. A SPANISH WINDLASS—Is used for heaving two s of a shroud together he nip, before passing seizing; and for y other similar pur-s. A strand is laid he top; the ends are ed underneath, and ght up on opposite s, the bights taken



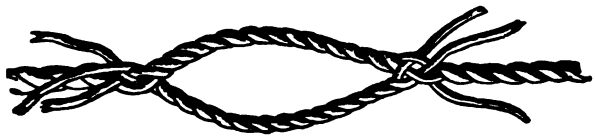
d a bar, or lever, laid on the top, a twist is taken in , and a marlinspike is inserted in the bights at each and hove round upon.

93. WORM, PARCEL, AND SERVE.—A rope is wormed der to give it a round snug appearance; the ends of rorming are seized round the rope, or tucked in, and wound along the lay. After being passed by hand,

Twist each pair up as you have done with them, to keep them in their places, and cut off the spare ends; grease the strands, *whole-knot* them together, stick them in once and a half, and cut the ends off. For a large rope, such as the fore brace, instead of knotting the strands, merely lay them alongside each other in the score of the rope, then put the ends in once, a half, and a quarter, and *back it* with the remaining quarter of a strand to taper it off. In splicing, instead of laying a strand over one, and under the next, you *back it* by putting the strand in, left-handed, under the strand you would otherwise have laid it over; which gives it an exceedingly neat and serviceable finish.

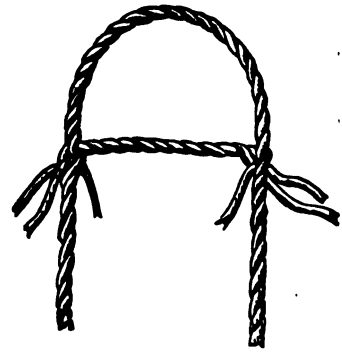
207. EYE SPLICE.—Unlay the end, and lay the strands on the rope the required length of the eye down from the bend; stick the midship strand under the strand of the rope on which it lies; lay the next end over this last strand, and under the next one; slue the eye over and stick the third end in under the third strand, put the ends, or half the ends, in again, and cut them off.

208. CUT SPLICE.—Unlay the ends, place them alongle each other in opposite directions, the one overlapping



: other equal to the length of the eye required. Splice : strands of each end in, as for an eye splice, and serve m over.

209. HORSE-SHOE LICE is formed like a t splice, but differs in ape, one leg being nger than the other.



210. GRECIAN SPLICE.—Say that the rope to be spliced a 7½-inch topmast backstay. Put a whipping on, lay the ends, lay the four strands up into ten yarn foxes, ort-splice the hearts together, and serve them hard over th yarn. Then marry the foxes, and pass the ends that upwards over the next downward one on the right, and

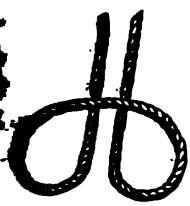
under the bight of the second downward one, working round to the right. Haul all parts taut, scrape the ends down, marl over hard, parcel well with tarred canvas and serve. This splice is particularly neat; and, as there are no bends in it, it is necessarily much stronger than a shroud knot.

211. SPLICING HEMP AND CHAIN CABLES TOGETHER.—Three chain tails being shackled to the chain cable, pudden, by laying strands of yarn along them; lay a 3-inch rope tail in with each: then marl down, parcel, and marl over. Put a whipping round the hemp cable, unlay the end, and unlay each strand; pick out the outside yarns, lay the strands of each strand up again, splice a 3-inch tail into the three strands of the cable, make the outside yarns up into sennit, and graft the splices of the tails over. Being now ready for splicing, lay the chain tails up for a short distance, and then short-splice each cable into the other in the ordinary way. Three seizings are next put on over the splice, the centre one of 2 inches, and the quarter ones each of 1½ inch. The tails are wormed along the cable, and secured with a couple of flat seizings, snaked.

212. A DEEP-SEA LEAD-LINE—Should be laid up, one end with the other, for three or four inches before splicing; for, being hard stuff, it is liable to draw.

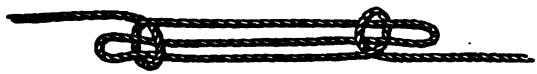
The marks should be tucked under a strand, after each knot is put in, and then they will lie flat along the line,

and run no risk of fagging out, or being torn off, which they are subject to if the marks hang loose.



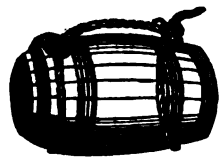
213. CAT'S PAW.—Lay the bight of the rope over the end and standing part, as in left-hand figure; then, with a bight in each hand, take three or four turns in them by twisting them from you; bring the bights together and hook on.

214. SHEEP-SHANK.—By laying the bight of the rope up



alongside the standing part, shorten it up as much as you require; and then take a hitch with the standing part and round the bights.

215. SLINGING A CASK—With butt slings. Reeve the end through the eye in the slings, slip the bight over one end of the cask, pass the slings round the other end, and take two half-hitches round its own part.



With Bale Slings.—Lay the slings on the deck, roll the cask over them, lift the bights up and pass one through the other, spreading them out well, and beating down as you get the weight of the cask.

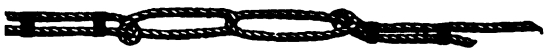
With a Rope's-end.—Make a bowline knot in the yard-whip, and stick the end back so as to form a short bight, to which bend the stay whip. Turn the bight of the bowline over its own part, and slip each bight thus formed, over one end of the cask.

With the head knocked in.—Slip the bight of the whip under the cask, take a hitch with each part over the head, and knot them together above.

216. TO SLING A MAN—In the most secure manner: make a bowline on a bight, shorten one of the bights up, seat him in the long bight, and put his arms through the short one.

217. BENDING TWO HAWSERS TOGETHER.—A *rowing*

end is about the best, with the ends seized back; :ead of that, a half-hitch through the bight of

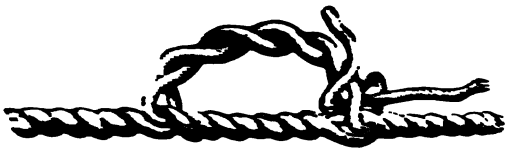


:wser is frequently used. If the bights are bowline l, instead of being hitched and seized, the end be thrust back between the standing part and)ight, to prevent it jambing, in the same way that a is often used with this knot; but with a heavy a bowline-knot often capsizes. If in a hurry, a bend may be used for small warps.

BENDING A HAWSER TO THE RING OF AN ANCHOR. hermen's bend, which is the same as a studding-sail ithout the end tucked back, is what is generally ut it becomes hard jambed with a strain. A *round* half-hitch, and the end stopped up, is far preferable; nay here remark, with reference to all purposes in hey can be used, that *two half-hitches will never ip or jamb.*

REEVING THE TURNS OF A SEIZING :H A SMALL EYE.—After reeving a turn eizing, splice the end you are working the bight; or, if you have already rove turns, splice it into the bight last passed, ork all parts round and round until it turns are completed, draw the splice, ure the seizing.

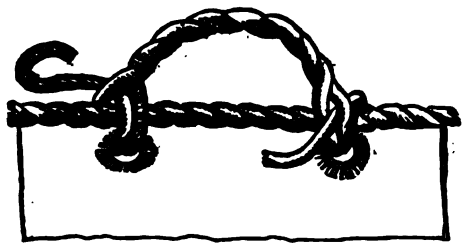
[illegible] To Make an Eyelet.—Unlay a [illegible] of the size that the eyelet is [illegible] to the left and put this strand [illegible] you are working it on; [illegible] ends of it through, so [illegible] by the two parts of [illegible] for the strand of the [illegible] a number of turns, ending [illegible] it from you under



[illegible] to the left; [illegible] strand [illegible] back [illegible] strand

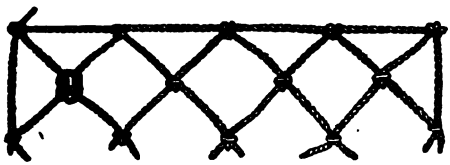
[illegible] to the right [illegible] two [illegible]

a cringle is to be worked into the leech of a sail, the



l is taken round the rope and through the eyelet hole
: sail; and the ends are finished off by taking a hitch
l all, and then passed under two, over one, and under
as before.

221. NET-MAKING.—Fill the needle, stretch the head-rope along, and begin on the left by securing the end of the to it. Regulate the size of the mesh by taking it your finger, and then clove-hitching it to the head. ı you have worked as far to the right as the head is ded to extend, get round on the other side of the nd work back again; but this row of meshes, and e subsequent ones, are formed by hitching them to

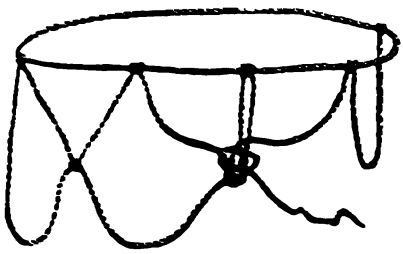


per row with a sheet bend. When the second row shed, shift round to the other side again, and work

the next row. The last row is hitched to the foot-rope, which is weighted with leads; the head-rope is floated with corks, and side-ropes are afterwards seized on.

To repair a seine, you cut it away until you get a straight row of meshes, and replace them as you at first made them.

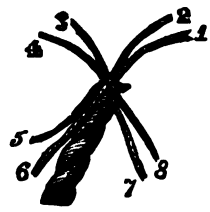
A shrimp or measure-net is made like a cabbage-net; the headrope is circular, the meshes are formed in the usual way, and the circumference of the net is reduced as you work down by bringing two meshes into one, at regular intervals: at first one mesh in a row; in the next row, two meshes; then taking up every fourth mesh, next every third in a row, and so on. Finish off by working a small grummet through the meshes at the bottom, to keep them together; and reeve two strops through the top of the hoops, so that by hauling them apart, the mouth of the net is drawn up.



223. BOATS' FENDERS.—A paunch mat fender is made of a piece of mat rolled up taut, with the ends of the foxes placed in the centre; the end is sewed to the part of of the mat where it terminates, and the edges are laced together. The lanyard of the mat forms the lanyard of the fender.

e usual fender for boom-boats is made of as parts of spun-yarn as will give it the requisite nsions. These are middled and doubled over nyard, and a small grummet is driven over the bights to make them snug. as in making a swab. It is then grafted over, either with sennit of foxes, and finished off as grafting is usually finished; or by crowning the end over with the foxes, as is shown in the left-hand figure.

u can crown in this way with any number of ends are a multiple of four, by dividing them into four , and laying a part down on each side; then bringing r on side 6, keeping the bight aying 6 over between 1 and 2, ing 2 over between 6 and 5, and 5 over outside 2; then laying r 1, under 6, over 2, and under over 5, under 2, over 1, under hen reeving 8 across, and lastly when it will be found that all the ends are secured. l the bights taut down, and either put a whipping d underneath, or tuck the ends under the grafting ut them off.



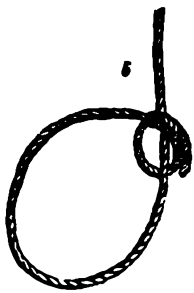
grummet fender is merely a rope grummet grafted

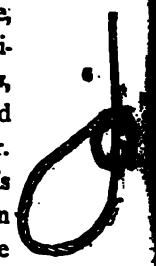
canvas fender is stuffed with oakum, roped at the

edges, and has a small grummet sewed on the centre, to keep the chafe off.

Leather fenders are used for gigs.

223. A CLINCH—Is termed an inside, or an outside one, according to the position of the end. In an inside clinch, *a*, the end is protected, and the clinch looks snugger. An outside clinch, *b*, is used for a cable, and in any case where the rope is not permanently secured, and where the strain is such as would jamb an inside clinch.

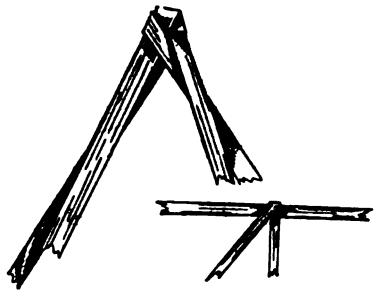




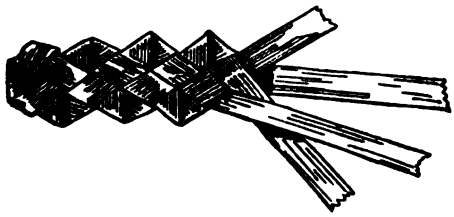
224. HAMMOCK CLEWS.—Take twelve lengths of nettle-stuff, middle them, serve round all at the centre, and pass a seizing to form the eye; then lay one up and one down, as for a sword mat, bring the outside nettle on each side across for filling and leave it out; form the other rows in the same manner, and when reduced to two, knot the last pair.

panish Clews—Are without plaiting, and are made by ing the nettles round below the seizing, leaving one on each side, at regular intervals.

35. SENNIT FOR TS.—Split the up, take a couple ths, cross one the other, dou- the underneath over the upper, the right-hand over one and er the other two,



what is now the right-hand one over two and under then the left-hand one over one and under two, and in the left over two and under one; then work two in the right, and so on. Join the grass when you come to end, by laying the end of another piece on the top,

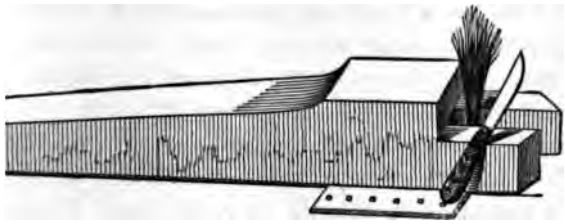


then go on working it in; and always join on the er side, because the under side is the proper *right* side he sennit. Afterwards clip all the ends off, and rub sennit down smooth with a bottle, or anything hard.

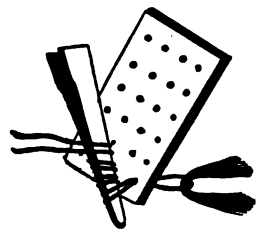
The button is form
of a broader piece of gra
It is first doubled sh
over itself, then 1 under
leaving a space, then
over 1, and down throu
the centre of the triang
next 1 over 2, and do
through the centre, com
out on the opposite si
and so on until an octagonal figure is formed.

The hat is begun
stitching the sennit to
button, commencing
the end finished off w
and working round
handed. The sennit
kept as slack as possi
and stitched through ev
other corner for the first few rounds; then afterwa
through three thicknesses of sennit, and through ev
corner, the stitch being kept out of sight, by the nee
being pointed underneath the strands of the sennit.

226. COIR BRUSHES.—Shape a piece of hard wood
the back (stave of a salt-meat cask, for example), burn
the holes in rows with a marlinspike; and out of anot
piece of wood cut a *former*. Make the coir up into fillin



rtionate to the size of the holes, pass the bight of arline down through the first hole, slip it over the , take a turn or two round the former, and heave the of the filling through the hole, up to the level of the f the back; then slue over, e filling between the notch former, and cut it off square, e bight of the marline down h the next hole, and in the manner proceed with each, ll are filled in.



. UNITS OF MEASUREMENT.—The size of spars, dead- nd chain, is expressed by their diameters; of rope, circumference; blocks by their length; hand masts ay spars), by their circumference, in hands, four feet he heel (the hand being four inches).

BERTHING SHIP'S COMPANY.—Begin on one side, l, and number off right across 1, 2, 3, 4, &c.; in this ien one watch is on deck at night, you have every ammock empty, and the same number of men off de of the deck. Fifteen inches is the general rule

for the distance apart of hammock hooks, allowing wh
practicable, more room for petty officers—boatswa
mates near the hatchways, boys, with a ship's corpo
and the seamen schoolmaster on one side of the m
deck. The guard, qua r-masters, signal-men, &c., w
have to keep night wa placed where they will be as lit
disturbed as possible, if the hands should be turned
early. Each man should have his bag given him, mark
with his number on the ship's books, on the bottom.

229. MESSES.—Every mess should have the same nu
ber of men from each watch belonging to it, so that t
weight may be equal when one watch is on deck; als
that you may have enough hands in the watch below
clean it. Marines and stokers have messes to themselve
boys, daymen, &c., should be equally divided amongst t
messes.

230. PROVISIONS.—Wet provisions are salt beef, po
suet, vinegar, lime juice, and rum. Dry provisions a
peas, flour, raisins, tea, sugar, chocolate, and oatmeal.

231. HOISTING IN PROVISIONS.—The "quarter," a
small stay tackles, should be used; the lower block
the "quarter" should be worked with a light whip
the yard. The quarter is taken round the yard and hook
to its own part after being triced up by a whip on t
lower lift.

232. OLD PROVISIONS—Should always be cleared o
of the holds before stowing the new; when the new a

nd, the old must be stowed on top, to be consumed

3. How, and where Stowed.—Provisions should owed in the holds, so that each kind can be got at, e proportion without breaking bulk; and as much ordance with the following plan as possible.

t provisions being the heaviest form the ground tiers, y provisions on the top; beef and flour on the star- d side, pork and pease port side.

aks are stowed fore-and-aft, bung up, fire-wood or ge being placed under the *chines*, to prevent their ng.

the spirit room, the casks are stowed bung up, and free; spirits should be carefully guarded, until the turned in the lock of the spirit room. Biscuit is ed in bags in the bread room.

efore commencing to stow, the holds should be oughly cleansed, and white-washed

4. Casks Marked.—Each cask has the contents, date of package marked on it, the bung is found ween the rivets of any two opposite hoops.

5. Slops—Consist of bales of cloth, flannel, drill, , jean, silk handkerchiefs, and bedding; casks of , marine clothing, soap and tobacco.

6. Size of water tanks.—The largest tank contains gallons, is 4 feet 1 inch square at the ends, and 6 feet ch in height, the next size contains 500 gallons, and is et 1 inch, by 5 feet 1 inch; and the 400 gallon tank

237. Stowing Ta
platform, built at the
tops level, and with
are, adjoining, so th
four tanks can be fille
more than a foot or tw

They should be w
Tanks are slung with a
with levers and tackles.

238. Starting a Ta
a rod, the lower part of
into a socket in the bo
through the top of the t
lets the water out below
for screwing in again, it
near the bottom.

239. Ballast.—There
3 cwt. each, they are

in slings, having four legs to it, and is hoisted in with main-yard and stay-tackles. Then "hands in launch;" *gallant yardmen and topsail sheetmen* "away aloft" ming in the starboard side—"starboard lifts"—"top ay," at once, and haul taut the topsail sheets. "Belay e lifts"—"lay out." Two burtons are hooked to each wer yard; haul taut and frap the burtons, lifts, and psail sheets, together with a small line from the top. Trice up, brace in," on which the stays are triced up; rd tackles lowered and the yards braced, so as to plumb e boat as much as possible, while still allowing her to ear the ship's side; braces and trusses hauled well taut.

"Lay in," "down from aloft"—hook the yard and ay-tackles; "haul taut the yards;" away with the yards king down the slack of the stays. When high enough, 'turn with yards," "away with the stays." Heave a line ut of the boat for a luff to bring her into place, and a ine and after forward to steady her. "Turn with the tays;" "man the rigging;" "lower of all," "away aloft." Let go the burtons, topsail-sheets, and rolling tackles; top away on the port lifts and get the squaring marks down at once. Then, "trice to hand"—"lay out." Unhook the stays, man the braces and bill and quarter ticing lines; "hold fast on the lower yards;" then "lower and square." "Square yards," and "down from aloft." When another boat has to follow, hook the stays to the slings, and the yards to the stays, the yards can then be unhooked and passed over again, whilst the first boat is being placed.

241. SHIP ROLLING HEAVILY.—The great thing to look out for is to keep the boat from being stove, while hoisting; therefore, take a whip to the bows of the boat, from the lower boom end. Run the guns in, lower the ports, be prepared to fend her off well. When well up to the nettings, hook the opposite stays crossed, and use bow and stern guys, from both sides of the deck.

242. YOU TOP UP FIRST—Because, otherwise, the lifts and burtons would bind against the topmast rigging, on pulling up.

243. CHAFING GEAR.—Paunch mats on the bunt of all yards between the yard and masts, well greased. A mat on the quarters of the topsail-yards in wake of the rigging. Breeches mats on the collars of lower stays (but here and elsewhere, bamboo scotchmen are preferable, when they can be obtained). A mat on lower yards to protect the sail where it takes the stay, when braced up. A mat under each leech-line block; hanging mats (or a hide) on the lower rigging, where the yards bind; on topmast backstays, for the same purpose, and in the wake of staysail pendants; on foremost swifter of lower rigging where the foot of the courses takes, and on the lanyards where the sheet chafes; on crossjack yard-arms, for the preservation of the spanker; and on the horns of the crosstrees, for the protection of the top-gallant sails. Battens should be permanently fitted on the sheet-anchor stocks, to prevent the hoops cutting the fore sheets; or a mat should be laced on.

:ount of the Fitting out of H.M.S. "Bellerophon."
ırds a brilliant example of what *can* be done in
y, when a ship's company are commanded by
ıossessing the requisite union of due seamanlike
inistrative qualities, and I give it as a high stand-
'hen all such work may be measured, and as an
ate pendant to the first section of our subject.

arch 7th, 1847, orders were unexpectedly received
ıo-gun ships "Rodney," Captain Edward Collier,
d "Albion," Captain Nicholas Lockyer, C.B., to
respectively, the "Bellerophon" 78, and the
ta," 84, then lying up in ordinary, the former in
uth, and the latter in Plymouth harbour.

ships, in common with all the "advanced" ships
ıary, had their lower masts, gun-carriages, chain
n 12-fathom lengths), stowed in their tiers, and
r tier of water-tanks on board; which state the
ɔphon" was in when the "Rodney's" *commenced*
ı Monday morning, March 9th. On the same
the topmasts were fidded, and mizen top-gallant-
inted. By Tuesday evening the top-gallant-mast
ded, running gear rove, and sails bent. At half-
on Wednesday morning she hauled off from the
ıd that evening saw her at Spithead with three
provisions and stores on board, awaiting orders
:ed to sea.

ship's company went ashore every evening, and
ir full time for meals every day; and thus a line-
ɛ ship was fitted out for a three months' cruise, in

every way ready to engage an enemy, in thirty working hours.

H.R.H. Prince Albert having visited the ship, and expressed his admiration of the skill and energy exhibited in the accomplishment of so unexampled a result, she was dismantled and returned again into ordinary.

244. WEIGHING.—Put the slip on, unbitt, and bring to (this is with a patent capstan) heave round, off slip, keep paying down the slack chain; hauling the cable from the capstan with chain hooks, and aft with hook ropes; when up to the bows, avast heaving on slip, haul enough cable forward for bitting and catting, bit the cable, bowse to to the compressor.

Hook the cat, haul taut, keep hauling, off slip, surge the cable, and away with the cat. When up to the cat-head, pass the ring stopper, hook the fish, ease up the cat, put on the stock pendant and bowse on it, haul away the fish. When high enough, turn with the fish, walk away the topping lift, pass the shank painter, ease up, and unhook the fish, and bowse in the slack chain.

245. SECURE AN ANCHOR FOR SEA.—After catting and fishing the ring of the anchor, will be the drift of the cat-block below the cat-head, and must be housed close up: to do this hook the cat to a strop round the lower arm of the stock; and bouse close up to the cat-head, haul taut the ring stopper, and unhook the cat; there are various ways of passing lashings when securing for sea round the stock and shank, which must depend much on the shape of the bow.

SECTION II.

AT SEA.

RULE OF THE ROAD.

246. CLOSE HAULED ON OPPOSITE TACKS.—The ship on the port tack is always to give way, if necessary, either by keeping away, or going about.

247. SHIPS WITH THE WIND FREE.—Give way to those on a wind; therefore, the ship on the port tack stands on.

248. TWO SHIPS HAVING THE WIND LARGE,—And meeting nearly end on, are to pass on the port side of each other; therefore the ship to the eastward keeps away, and the other hauls up.

249. UNDER STEAM,—And *nearly* end on to each other, both port their helms and pass on the port side *(see the order in council of the 30th July, 1868, respecting port helm)*, when meeting not end on.

250. A STEAMER—Always gives way to a sailing vessel, and it must be remembered that every vessel under sail, with steam ready, though not using it, is considered a steamer in the event of collision.

251. EVERY VESSEL UNDERWEIGH—Is to carry a green light on the starboard, and a red light on the port side;

steamers in addition carry a white light at the foremost head. The side lights to be fitted with inboard screens, projecting at least 3 feet forward from the light, so as to prevent the light from being seen across the bow. Vessels towing, carry two white mast-head lights.

252. DURING FOGS—Vessels under steam are to sound a steam whistle; vessels under sail to use a fog horn; at anchor, ring a bell.

These signals to be sounded once at least every five minutes.

253. MAKING PLAIN SAIL.—"Clear lower deck;" "make all plain sail, starboard tack;" "upper yardmen aloft;" man the topsail sheets and halliards; "away aloft;" "trice up, lay out;" "hoist the jib;" "let fall, sheet home;" upper sails to be kept up until the topsails are nearly mastheaded; then let fall by order, sheeted home and hoisted.

As each sail is let fall, the loosers should lay in, and move smartly down from aloft.

"Port braces"—"fore and main tacks;" "brace forward;" "let run, haul on board"—when the sails are set, and yards braced up; "haul taut weather braces, lifts, and trusses;" coil down ropes.

254. TACKING.—Keep the ship full for stays, and give the word "Ready, O!" to enforce attention. *Ease* the helm down, that her way may not be too suddenly checked. Haul over the boom; and, when the helm is down,

"Helm's a-lee!" on which the fore and head sheets are let go and overhauled. When the wind is out of the mainsail, "Raise tacks and sheets," keeping the fore tack fast till the main-yard is hauled, for as the foresail bellies in to the mast (which it always does to a certain extent when the fore tack is let go), it becomes a back sail, and retards the ship in coming to. This is still more the case when, in a strong breeze, it becomes necessary to check the fore bowline, to relieve it of the undue strain brought upon it. The top-gallant bowlines at the same time are let go, the lee main tack shortened in, the weather after (preventer) braces, and lee maintop bowline manned; and when the wind is ahead, as a general rule, or, in quick working ships, a little before, taking the main top-sail as your guide,—the weather leech of which will be well aback, or, in a dark night judging by the shaking of the spanker—"Haul well taut; mainsail haul!" The after yards are swung and braced up as far as the fore yard will allow—the lee head braces, in short ships, being checked for that purpose, the maintop bowline run away with, and a turn taken before the main-yard can fly back again, main tack boarded, and sheet gathered aft, head sheets shifted over, and boom sheet eased off. When all safe, and the after sails begin to fill, the head bowlines are let go, the head yards braced round, and the fore tack boarded, to the order "Fore tack, head bowlines—Of all haul;" if, however, she has paid off too rapidly, the head yards should not be braced up till she has come to, or is coming to the wind. The main yard is now braced up, and the sheet hauled aft. The helm is righted if she loses her way, and

shifted over if she gathers sternway. The lee breast backstays, when used, are borne abaft, and the weather one crutched and pulled up in stays. Finally, the yards are all trimmed, the weather braces hauled taut, the weather lifts bowsed up, and the bowlines hauled. When done, pipe the sweepers, call the hammock stowers and coil down ropes—every man a rope, and every rope on end.

255. TOP-GALLANT BOWLINES—Are let go, when you raise tacks and sheets, because, when the sails are aback, if the lee braces are not quite taut, the whole strain of the top-gallant sail, and great part of that of the topsail would come upon them; and, also, that they may be cleared away in good time before the yards are hauled.

256. THE LEE FORE TACK—Is not shortened in like the lee main tack, because, by doing so, you would make a back sail of it, and prevent the ship coming to.

257. TACKING IN LIGHT WINDS.—Keep away a little, and get as much way on as possible, before putting the helm down.

Man the head sail downhauls; ease the helm down; check the lee head braces, and head bowlines.

"Helm's a-lee;" haul down the head sails; brace the head yards up as she comes to the wind; when nearly head to wind, brace round the yards on the mizen mast; and when the wind is fairly round on the other bow, haul the main yard, and hoist the head sails.

258. MISSING STAYS.—On port tack.—Haul aft the head sheets, put the helm a-starboard, raise the main clew-

garnets, brail up the spanker, and square the after yards. Then, when she fills, either brace up again on the port tack, and try it again; or, let her come round on her heel, squaring the head yards when the wind comes aft, shifting the helm as she gathers way, and bringing her to the wind on the starboard tack.

259. DANGER ON THE LEE BEAM.—Run the weather braces in, and make a stern-board till clear.

260. TACKING IN A BREEZE.—Ease away the weather head-braces with a turn, keeping a strain on them when the yards fill, and standing by to belay in time; for, if let go and overhauled, as in moderate weather, a sprung yard would be the possible consequence.

261. THE LARGER HELM—Carried in the freshening breeze, is occasioned by the increased immersion of the bow, which throws her up into the wind; and, owing to the oblique direction given to the rudder as the ship heels over, much of the effect is lost, and a greater helm is required in consequence.

262. ABOUT SHIP, UP MAINSAIL.—Instead of "raise tacks and sheets;" it will be, "raise the fore-tack;" "up mainsail" and "maintopsail haul;" instead of "mainsail haul."

263. THE DISTANCE GAINED TO WINDWARD.—When lying within 5½ points. of the wind, is 47 per cent. on the whole distance run; as you will see by reference to a transverse table.

264. THE ACTION OF THE RUDDER—Causes a ship to rotate on an axis before the centre; the exact position of which depends upon the build and rig of the ship. A Chinese cargo-boat will fly round with the bow almost stationary.

265. A SHIP HEELS OVER—At first from the sudden action of the wind upon the sails; and she rights as she gathers away, from the increased lifting pressure of the water on the lee side.

266. TO FORE-REACH IN STAYS.—Ease the helm down very gradually, haul the main yard the moment you can insure her staying, and, in a fresh breeze, keep fast the fore sheet if the ship works well.

267. TO AVOID FORE-REACHING.—Round to quickly, check the lee head-braces, and make a late haul of the main yard.

268. STEAM AND SAIL.—Tacking with the watch, look out and haul the after yards quickly, or you will have a bother with both them and the head yards if she gets on the other tack before you.

269. TO WINDWARD.—Your companion is the weathermost, for a line drawn from her at right angles to the wind will fall to windward of you.

270. TAKEN ABACK.—As she will lie her course on the other tack, pipe "Watch about ship;" raise tacks and sheets, brace round the after yards, board the main tack, attend to the helm, and haul the head yards as in tacking.

hould she refuse to come-to to starboard, and has lost way, port the helm, up mainsail, in spanker, square the yards, and wear round.

hen taken aback with the wind on the lee bow, there f course, no help for it but to go round; but if the l is ahead or on the weather bow, and you do not wish o on the other tack, you box her off with the head s; that is, if flattening in, easing the boom over, &c., ot sufficient.

71. WEARING UNDER PLAIN SAIL.—Up mainsail and panker: put the helm up. "let go the bowlines—round e after yards;" keep bracing in as her head pays off, ering the mizen topsail, but keeping the main just lift-

When the wind is aft, "raise the fore tack"—"square head yards." Brace forward the after yards and bring to the wind; haul out the spanker, brace up, set the nsail, and haul aft the head sheets. It is a good plan, ticularly if wearing with the watch and using steam, to e the head yards right up on the new tack, after squar- them, before manning the after braces.

172. WEARING SHORT ROUND.—Starboard tack before ng round. Throw the ship up in the wind to deaden t way; haul up the mainsail, and brail up the spanker; ce the head yards a-box, and square the after yards; the helm a-port when she gathers stern-way, amidships en she loses it, and a-starboard when the after sails fill d she gathers headway. Square the head yards as in earing, and when you have brought the wind on the port

quarter, brace up the after yards, haul out the s
and board the main tack.

273. WEARING IN A GALE—With a heavy sea r
requires great care, and a temporary lull in the
should if possible be taken advantage of. Trusses, pr
braces rolling, and relieving tackles, must be c
attended, plenty of way should be kept on the shi
the helm may be well answered.

274. WEAR IN A STORM, WHEN ALL OTHER
HAVE FAILED.—By manning the fore rigging as thi
the men can pack, ships, under the circumstances
in the question, have wore when all previous at
were unsuccessful.

But a sea anchor, or stop water, with a hawser fr
quarter, will do better, if you can launch it.

275. SHIFTING OVER STORM STAYSAIL-SHEETS.
general plan, and I think the best, is to haul do
sail, shift over the sheet, steady aft and hoist, but
be done by using luffs as sheets from the opposite

276. WEARING UNDER STAYSAILS.—Put the hel
brail up the after trysails, and turn the yards as wi
set. In a very heavy sea it may be necessary to d
reefed foresail for the purpose of keeping way on th
and preventing her being pooped, even at the risk
being able to furl it again. In the mean time shi
sheets over, and steady them aft; when before the
set the after sails, and haul down the fore and

setting them again as soon as the sheets are
er.

ETTING STUDDING-SAILS.—"Hands trim and make
lding-sails both sides." "Away aloft." "Main
ets and buntlines, spanker brails." "Up mainsail,
"Weather braces, lifts and trusses. Raise the
round in." When ready with the studding-sails,
opping-lifts, fore guys, topmast and top-gallant
sail halyards." "Haul taut." "Rig out, trice to
On which the lower booms are topped up, and
orward, topmast and top-gallant studding-sail
gged out, topmast and top-gallant studding-sails
to the yards, head stops cut, sails launched over
blocks, and the slack of the tacks taken down.
r halyards are then manned by the hands from
ng-lifts and fore guys, and at the word "Hoist
erything goes out together.
vise, "Boom-jiggers, topmast and top-gallant stud-
halyards." "Rig out, hoist away." The sails
set as quickly as possible independent of each
ıd when set, and the lower studding-sails ready,
opping-lifts, fore guys, lower halyards." "Top up,
ıy."

TAKING IN STUDDING-SAILS.—"Hands shorten
dding-sail downhauls." "Away aloft." "Top up
booms." Lower studding-sail tripping lines, top-
l top-gallant studding-sail downhauls, boom jiggers
r guys manned; then "Haul taut, trip up the
ıdding-sail, shorten sail."

It may not be out of place here to make a few upon the fitment of studding-sail gear.

Lower studding-sail tripping-lines are best rove (commencing at the clew), through an eyelet-hol centre of the sail, and up before all through the l the inner yard-arm.

Lower studding-sail yards, half the usual lengt the sail much easier to handle.

A long lizard for the lower boom topping-li through a block at the fore yard-arm, through a the slings, and thence on deck, is preferable to t lizard taken out by hand.

Lizards, both for topmast and lower studding-s an improvement on rope-yarn stops. For this p strop, with a thimble seized in, should be fitted outer arm of the topmast studding-sail yard, and t spliced close outside it, round the yard. After th rolled up, a turn is taken round the sail and halya through the thimble, passed along the sail to t and hitched round the sail; the bight being between its own part and the sail, so that wher upon, or a turn taken round the lower lift and the hoisted on, it comes adrift. For the lower stud a strop attached to the lizard is merely put round a toggle, into which the lizard is spliced, put thr bight, a turn taken on the forecastle when high and the sail hoisted.

An enlarged topmast studding-sail may be set b of a jack yard laced to the outer part of the f

: bent to the centre; and a fore topmast studding-sail
t may with advantage be kept rove through a tail-block
the bunt of the fore yard, where, practically, whatever
may do in theory, it requires no attention when trimming
ls; and abaft, there is only one rope, the boom-brace,
attend, instead of two.

Instead of taking a burton out on the topsail yard, let a
ndant be fitted, rove through the span-block (double),
the mast-head, with a hook on one end to take out on
e yard, and a thimble at the other to hook the burton
, the single block of which is hooked to a strop round
e eyes of the lower rigging.

Let the topmast studding-sail downhauls be led through
tail-block on the topsail-sheet or some convenient place;
hich slip directly the yard comes down to it, running
way with the downhaul, and bringing the sail in without
check. The deck sheet should be rove through a
ading-block.

Have top-gallant studding-sail downhauls bent to the
ner yard-arm, and rove through a timble in the inner leech.

279. After setting a Topmast Studding-sail.—
eady taut the deck sheet, get hold of the short sheet,
eeve it through a tail-block on the quarter iron, bend it
o a ropes-end out of the top, haul it up, haul aft and
elay it; *then* come up the deck sheet, bend it to the
ownhaul, and pay them down before all; afterwards,
hift the boom jigger for rigging in,—or, instead of shift-
ng it, overhaul the hauling part, hitch it to the heel of the
boom, and rig in with the single part.

are again bent re
topsail yard, and

281. FLYING L
and run a few eyle
in from the outer c
studding-sail, or bo
and, as the outer le
inner one, put a sei
to the bight, and set
the clew will imperfe

282. FORE TOPM
Round down on the
pull up and lift the b
knot to round down

283. HEEL LASHI
boom is secured roun
studding-boom, throu
jackstay.

hrough the bights of the strop, and toggled—is r secure, equally neat, and far more convenient for ıg and unbending, which you must do every time ke in the sail.

;. DIPPING A TOPMAST STUDDING-SAIL BEFORE-—Send a couple of hands on the lower yard : lower ıil well down, and let them gather it in until they get of the outer leech which is then gathered down, until ıner yard-arm can be canted before the leech of the il, then let go, and hoist away.

should be remembered that a touch of the helm may a good deal in setting and taking in studding-sails.

36. DIPPING A TOPMAST STUDDING-SAIL ABAFT-ALL.—ıer down on the *inner* leech.

37. HITCH WITH THE DOWNHAUL ROUND THE W.—Let the boom come in, gather in on the foot, lay l of the clew, and then clear the downhaul.

88. GEAR TRICING-LINE.—The lower studding-sail ping-line is used, bent to a strop and toggle. The lding-sail gear should be kept aft, stopped along the st ridge ropes, and merely triced up, instead of being pped along the fore yard.

89. SETTING STUDDING-SAILS—*With a swell on*, with-t much wind to steady the sails, haul taut the buntlines d bowlines before laying out on the yards.

290. REEFING TOPSAILS—Topmast studding-sail set; lower the topsail *when the burton or preventer lift is off the yard*, the studding-sail being in.

291. COMING TO THE WIND.—Take in the royals, and one or two reefs; the jib, and a reef in the spanker if necessary. While reefing, bring the ship to the wind under the courses.

292. GETTING SHEETS HOME.—Always get the lee sheet home first; then ask the officer of the watch, if necessary, to give her a luff up, and get the weather sheet home while the sail is lifting.

293. LEE BOOM-SHEET.—By hauling it taut, you would endanger the boom.

294. LIFT AND BRACE OFF.—Lower the sail, get hold of the leech, cant the yard, and rig it from the topsail yard.

295. BREEZE FRESHENING.—1st. In royals and flying jib. 2nd. In first reef of topsails. 3rd. In second reefs, and mizen top-gallant sail. 4th. In fore and main top-gallant sails, jib and spanker.—Set fore topmast-staysail and mizen. 5th. In third reefs and reef of courses. 6th. Close reef the topsails, down fore topmast, and set fore staysail. 7th. In mizen topsail. 8th. In fore topsail, courses and mizen.—Set main staysail, and mizen trysail. 9th. In main topsail—if you think it advisable. Yards and masts sent down, and other precautions are of course supposed to be taken.

296. REEFING TOPSAILS.—"Clear lower deck," "reef topsails," "two reefs;" "weather topsail braces," "hands the topsail halyards," "away aloft;" "let go the topsail lines, round in;" "lower the topsails," then haul out the reef tackles, turn the yards to the wind, and haul taut the braces, steady taut the top-gallant clewlines to keep the sheets clear of the men reefing; "trice up, lay out;" the sail is then lighted out to windward, the weather earing hauled out, then to leeward; pass the beckets through the reef-line and toggle them; "lay in down from aloft," "let go the reef tackles, attend the braces." "Hoist the topsail."

297. REEF-TACKLE CARRIED AWAY.—Clew the sail up, pass the leech along and reeve the reef-tackle afresh; haul out, take the reef in, and sheet home.

298. PASSING AN EARING.—Haul the reef close out by the outer turn, passed down abaft, through the cringle, up before the yard, over the cleat, down abaft, and the bight passed through the cringle, leaving the end abaft the sail. Pass the bight up before and over the yard, rousing the reef well up, then haul back on the end till the bight lies close down on the yard; pass the end through the bight from abaft, haul well back and hitch it. For a third or fourth reef, as many inner turns are passed as the cringle will admit of, and are passed on the end—not on the bight.

299. FITMENTS OF EARINGS.—Those of the first and

second reefs are usually formed of two pieces of small rope; the longest spliced into its own part, forming an eye two-thirds the length of the earing; the other, spliced into each part of this eye, at equal distances apart, the bight of the two parts lying square with each other. This tapers the earing, the end consisting of one part, the third quarter of two, the middle of three, and the part which forms the first turn of the earing, of four parts. All are marled together; and a seizing is put round the bights, making an eye to go over the yard-arm.

The third and fourth reef-earings are formed of a single part, and are spliced into the eyelet-hole in the sail through which the lower turns of the cringle are passed, and seized up outside the cringle.

300. AFTER TAKING IN A THIRD REEF—Get the preventer braces and preventer parrals on.

301. TAKING IN A CLOSE REEF.—Man the weather brace, rolling-tackle, and clewline, round in, lower the topsail and clew down; check the lower braces if on a wind, haul the reef-tackles close out, easing the sheets, and hauling up on the clewlines at the same time; haul taut both buntlines, secure the yard (not forgetting to haul taut the halyards, as it is hanging by the lifts), trice up and lay out.

A close reef-earing is usually passed abaft all, as there is such a mass of sail and leech-rope on the fore part, but it is nevertheless doubtful whether the usual plan is not the best for all reefs.

302. REEFING COURSES.—Haul the clew-garnets two-blocks up, and haul up the reef-tackles and buntlines. If it is a wind, round in the weather-brace, to clear the sail of the stays; haul taut both lifts, and rolling tackle if on, and truss to; lay out and light over.

303. TAKING IN A COURSE.—Man the weather clew-garnet and leechlines, and both buntlines; ease off a little of the main sheet, before starting the tack, lest you spring the yard by suddenly relieving it of so great a strain; then ease away the main tack and bowline, and haul up the weather clew, take in the lee clew, haul the tack close up, round in the weather brace, and secure the yard for furling (which may be done over all, without reeving the booms up). When furled, place a mat, or old hammock, over the sail in the wake of the stays, previous to bracing up.

304. SETTING A STORM STAYSAIL.—Haul the sheet well aft before hoisting, having seen the hook moused; ease away as you hoist, and haul aft again.

305. SENDING TOP-GALLANT MASTS DOWN AT SEA.—Get burtons on the backstays, to ease away as you sway to unfid and to steady taut as you lower. Send the mast down through lubber's-hole with a heel rope rove through a block on deck abreast of the mast, well manned, and kept taut as the mast comes down.

306. SET THE FORE STAYSAIL,—*Then* shorten sail in the usual manner.

307. TAKING IN A JIB IN A BREEZE.—Keep the ship away, and make use of the gab-rope.

308. WEATHER MAIN-TOPSAIL BRACE GOES—On a wind, put the helm down, let go the lee main brace, square the main-yard and bring her to the wind with the topsail aback, lash the yard to the topmast rigging, lay out, and put on the preventer brace.

309. WITH THE WIND ON THE QUARTER.—Watch trim sails; keep her away, let go the halyards, bring the wind on the other quarter, get a preventer brace on, trim and make sail.

310. PREVENTER BRACES.—Yard-tackles for the lower yards, and the long 3½-inch top-whips for the topsail yards.

311. WEATHER MAIN-TOPSAIL SHEET AND CLEWLINE GONE.—Haul up the buntlines, reef-tackles, and lee clewline; hand the leech in, pass a gasket round the sail to steady it, and reeve the clewline afresh. If, however, you cannot get hold of the leech, unreeve the main top-bowline from the fore top, send a hauling-line down for the end, reeve it through the quarter block, haul it up, and so confine the sail till you have passed a gasket, when reeve the bowline again, and the new clewline and sheet.

312. PARRAL OF MAIN-TOPSAIL YARD GONE; BEFORE THE WIND.—Haul taut both clewlines and topsail lifts to steady the yard, and see that the braces bear an equal strain; but do not clew up, as the great object is to keep

as steady as possible. Without delay, hang the
it mast rope at the cross-trees, unreeve it alto-
lip it under the rigging, and make a running
with it round the mast and topsail-tyes; open it
send a hand down with it, and slip it over the
s. In the mean time, hands are employed reeving
ng part through a leading block abaft; clap the
, and truss the yard to; get up the spare parral,
ie sail again. If the yard complains, ease off the
eets, hauling taut the clewlines.

ore remarked, we are not bound to assume that
t of proper care these accidents occur. Therefore,
case were put as the carrying away of a parral *in*
wind, we should merely suggest that a new one
and got up, and another preventer passed in the
ie; for the sound preventer parral, that under the
inces would be on, would relieve us of all
sion.

PARRAL GONE, ON A WIND.—Heave the sail
d clew the yard down, hook a couple of jiggers
cap for rolling-tackles, clew up if necessary, and
reventer parral on.

TOPMAST-STAY CARRIED AWAY.—Keep the ship
orten sail, get up and haul taut the sail-tackle;
ace the stay with a hawser, bowline-knotted round
-head.

A BOBSTAY GONE.—Take in the top-gallant sails,
ls, and spanker, haul up the mainsail, lower the

fore topsail, and keep away if necessary. Send a hand down to knot both parts of the bobstay together—forming a strop; hook the double blocks of two luffs to it, and the single blocks to a strop through the heart in the bobstay collar; reeve the falls through blocks on the bowsprit, set them up and make sail, keeping away and getting a pull of them occasionally.*

If the shroud be gone close to the cutwater, it must be cut away with an axe, and a strop rove through the hole, if it can be got at. But, if in such weather that you cannot send a hand down, you must send the fore top-gallant mast on deck, get the jib-boom in—if it is safe to start it, and the runners and tackles up to relieve the stays, and ease the sail carried, until the weather is fine enough to secure the bowsprit effectually. I cannot see that a hawser, taken round the bowsprit and led in through the hawse-holes, would be of any utility, from the small angle it forms with the bowsprit; and in bad weather you would not be able to keep the hawse plugs out.

316. JIB-BOOM CARRIED AWAY.—So much depends upon ever-varying circumstances, that what is recommended in this and similar cases, must only be considered as generally applicable, and not suitable or necessary on all occasions. As a general rule, therefore, heave to and get the wreck in, taking in the top-gallant sails, and housing the fore top-

* NOTE.—This is the correct answer without doubt, but the reviser has seen two bobstay collars out of three, gone in a heavy gale of wind, and nothing the worse, though they could not be replaced until the weather moderated.

lant mast. If you bear up, or stand on, you will knock
bows about with the broken spars, and find great diffi-
lty in getting hold of them.

317. JIB-SHEET CARRIED AWAY.—*Mind your weather-*
w, haul down the jib, trice the tack of the spanker up,
d clear away the fore topmast-staysail.

318. MAIN TACK AND CLEW-GARNET GONE.—Bear up,
wear, and haul the sheet aft.

319. TILLER-ROPE CARRIED AWAY.—When this occurs,
may be assumed to be blowing fresh. The first thing
be done, therefore, is to steady the rudder, which, in a
a-way would fly from side to side with great violence.
he quickest way of doing so will be by means of the re-
aining rope; and, as the chances are that the weather
heel-rope will be the one to go, jamb the helm down,
horten sail, and heave to with the head yards a-box, if
ou do got want to come round. Otherwise, if there is a
hip close astern of you, for instance, haul the mainsail
p, and square the main yard in stays. Should the lee
ope go, put the helm up, heave to on the other tack, and
horten sail as soon as possible. If unsafe, from the
osition of the ship, to do either, chock the rudder up
(which, by the way, is not done in a moment when the
tiller has taken charge); man the head sheets and cross-jack
braces, and steer the ship by the sails. In moderate
weather, the relieving-tackles will probably be hooked
before it will be necessary to touch anything. In all cases
send hands down to hook, and work them, and reeve new
wheel-ropes.

320. LOWER SHROUD CARRIED AWAY, AND NOT LONG ENOUGH FOR TURNING IN AFRESH.—Turn the dead-eye out, strop it with rope of equivalent dimensions, and seize a large thimble in; knot the shroud, reeve it through the thimble, and seize the end up; reeve the lanyard again, and set the shroud up.

321. JIB DOWNHAUL CARRIED AWAY.—Unbend the lee top-gallant bowline, make a bowline round the stay, and haul down. Should it carry away, send the downhaul up by the weather bowline used as a hauling-line, bend it round the stay, and assist it, if the lacing jambs, by hauling down six feet at a time with a rope's-end rove through the lee bowline block at the boom-end.

322. MAIN YARD SPRUNG ON THE WEATHER QUARTER; SHIP ROLLING HEAVILY.—Unbend the sail, clew up the top-sail, reeve the jeers and take them to the capstan. Send the studding-sail booms down to lighten the yard, and to get them out of the way. Send an up-and-down on each side through lubber's-hole, lash them to bolts in the cap, and hook them to butt slings round the quarters of the yard. A little further out, on each quarter, hook the top burtons to strops on the yard, and on deck to bolts in the fore part of each gangway. Lower the yard-tackles down, cross them and hook them in to the ship's side abreast of the mast. Unshackle one truss, and reeve a stout piece of rope down through one thimble, abaft the mast, under the necklace, and up through the other thimble of the truss stop; to each end hook a burton from the

t, and unreeve the other truss. Heave round
ıying on the quarter tackles at the same time,
ılip off, and walk back, attending the lifts,
preventer truss, and braces, and steadying
ward by the burtons. Land it across the
lash it there. Strip it of everything in the
nock off the battens and casing to have a
ıl. If found sprung where it was supposed,
ast studding-sail boom on the top of the yard,
ɔn the fore side—supposing the fracture to
ı there; fill the space up above and below
th capstan bars, and handspikes, &c. Get
o fathoms of 3-inch and 3½-inch rounding,
ging, if you have it; divide it into six lash-
n each quarter, outside the clothing. Pass
on both ends, each turn bowsed well taut
rack each turn as it is bowsed taut by driv-
ough it into the yard, and, when finished
with wedges. Then put on the slings, which
lengthening; lash the clothing on, having
hings; and sway the yard up, in the same
hich it was lowered down.

t spring, an iron fish will probably be sufficient
opening out and spreading further.

: YARD CARRIED AWAY IN THE WEATHER

Clew the topsail up, confine and steady the
l-arm by slip-ropes, and unbend the sail the
ı can; hook an up-and-down from the cap

...knight-heads, and
side, level with the
portion of the yard.
heads, on the weathe
rigging, and steadied t
Bring the broken pa
crossed from opposite s
with studding-sail boo
above the batten, anoth
on the fore side; fill
whole together, and wed
done, the fore tacks a
shackled to the clews of
fying. When finished, s
set the sails.

324. SWIFTING IN.—Re
each shroud, and bowse or

325. MAINMAST GOES O

it with sail-tackle, and slacken up the stays, if circumces require it. Get head sails and flying-boom in; , if the bowsprit is so badly sprung as to lead you to k that it would be unsafe, when fished, to carry the with the boom rigged out the full extent, rig it in for a until the heel buts the stem. Place the flying-boom one side, and a topmast studding-sail boom on the er, and would all together, wedging and chocking up tween. Out of the head-ports on the forecastle, rig, on e side, the spare jib-boom, and, on the other, a handt, or spare mizen-topmast; secure the heels inboard, d lash the heads securely to the head of the bowsprit either side. Round the centre of one of the shores, re the standing part of a lashing; reeve it down ugh the gammoning hole in the cutwater, up and over opposite shore, down through the cutwater again, over first shore, and so on until sufficient turns are passed, shing off with a few frapping turns round the lashing over the bowsprit. The jib may still be set outside bowsprit cap.

f you intend to get the jib-boom out again, fish the sprit with one or two spare anchor stocks hollowed assisted with the shores as before.

27. BROUGHT BY THE LEE.—Put the helm down, and e round directly, unless in the mean time she answers helm, and brings the wind on the weather quarter ; though the probability is that you will either lose nasts or be thrown on your beam-ends.

328. LAYING A SHIP TO.—Haul the foresail up if you find that you can run her with safety, for t time under the topsail and staysail, furl the foresail bringing her to the wind. If, however, there is suc running, that you cannot keep before it after sho sail, look out for a smooth, down with the helm, and short to, to avoid exposing her broadside to the moment longer than is absolutely necessary.

329. BROACHING TO—Is synonymous with com into the wind; but is exclusively applied to a ship weather, when it becomes a situation of great da the ship and spars. When running free, with the the quarter, want of attention at the helm is the c cause of such a mishap. Put the helm up, lower t sails if they are standing; and, if she does not pay off or brace up, as the occasion demands. Should ever the ship be going over, let fly everything, of instantly.

330. PREPARATIONS FOR A HURRICANE.—Have of steam up; get the jibboom whiskers and dolphin in; send upper yards, masts and rigging on studding-sails out of the rigging, and booms off the Rolling tackles, preventer braces, and parrals on. staysails bent and ready for setting. Sails close yards well secured, and rigging mats properly pla prevent chafe. Gratings, tarpaulins and battens re the hatchways. Life-lines along the decks; guns, bucklers, and hawse plugs, boats, booms and a well lashed and secured. Ports examined and well

lieving tackles, spare wheel and binnacles ready. pumps to insure their being clear and ready for

two or three days provisions in advance. Set the ils, and take in the topsails in time; see them well ith sea gaskets. Register the barometer every r; make yourself all clear "on the law of storms;" e your ship on the right tack.

THROWN ON YOUR BEAM-ENDS.—Let fly every- hen, if she does not right, or continues to go over, no resource left but to cut the lanyards of the rigging, if you have time, and let the masts go e side; at the same time cutting the lashings of ms, and clearing away the boats. If in soundings, go an anchor will bring her head to wind and y right her.

DANGER OF FOUNDERING.—Rig a sea anchor, ee spars in the shape of a triangle, and lash a sail it; at one corner sling a weight proportionate to of the spars, launch it overboard, and ride by it ry-masts can be rigged. If unable to do this, go an anchor, and veering a long scope (if possible cable), will in some measure steady the ship by her head towards the sea.

WATER GAINING ON THE PUMPS.—Heave what u can overboard, and otherwise lighten the ship mstances will admit.

334. THE LAWS OF STORMS.—The culpable disaster detailed in the question resulted from disregard, or ignorance of these well-known laws, which, had they been attended to, would not only have enabled your friend to avoid all danger from the approaching storm, but would have taught him how to profit by it, and unhesitatingly to turn it to his own advantage. I have space here only to touch on the first principles of this very attractive science; and, for its interesting particulars, must refer the reader to the standard works of Piddington and Reid.

But five-and-twenty years have elapsed since Mr. Redfield, of New York, first drew public attention to the rotatory and progressive motions of storms, which resulted in the discovery of the following laws:—

1. That, in the northern hemisphere, their axial rotation is in a direction contrary to that of the hands of a watch, or W. E.; and that, in the southern hemisphere, they rotate with the hands of a watch, or W. E.

2. That, though some cyclones are almost stationary storms, the majority move onward on a curved track, at a rate varying from one to ten miles an hour in the Southern Ocean, and from ten to forty in the West Indies; that, near the equator, their course is nearly west, diverging to the north in north latitudes, and to the south in south latitudes, until they cross the tropics, when the curve becomes more rapid, and they finally re-curve to the east-

ward. Their dimensions vary from 200 to 600 miles in diameter in the South Indian Ocean, and from 100 to 1,000 miles in the Atlantic. The usual typhoons of the China Sea are from 60 to 300 miles in diameter.

3. That there is generally a calm space in the centre, where sudden and terrific gusts break the unnatural repose, with a confused and dangerous sea running.*

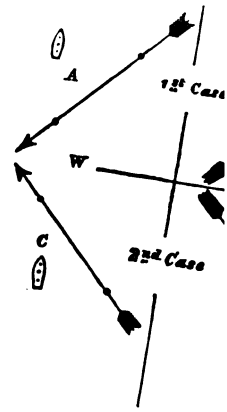
4. That in the northern hemisphere, the centre bears eight points to the left of the wind, your back being to it; and, in the southern hemisphere, eight points to the right of the wind.

5. That cyclones are almost always preceded by a falling barometer.†

6. That, to avoid them, you should, when to the right of the cyclone's track, or in the right-hand semicircle, lie to on the starboard tack; and, in the left-hand semicircle, or to the left of it, on the port tack, in both hemispheres. But this, as will subsequently be seen, only holds good when you are far enough from its path to be out of harm's reach, for it then insures you against closing within dangerous limits, and from being taken aback from the shifts of wind, which, if this rule is attended to, will always be aft.

* In the hurricane that passed over Martinique, October 11, 1831, 9,000 people perished; and at St. Pierre the sea rose to a height of 25 feet, and 150 houses along the beach disappeared in a moment.

† In the hurricane at Havannah, on October, 12, 1846, the fall of the barometer was so sudden, in the vortex, that the windows of the houses were forced *outwards*.



you are in the right-hand
the wind veers in the c
are in the left-hand sem
first case (see diagram), in
travelling from eastward to
from westward to eastward.
In the second case (see dia
course is from eastward

agram B,	at first	North	West
	afterwards.....	East.....	North
agram C,	at first	North	East
	afterwards.....	West	North
agram D,	at first	North.....	West
	afterwards.....	West	South

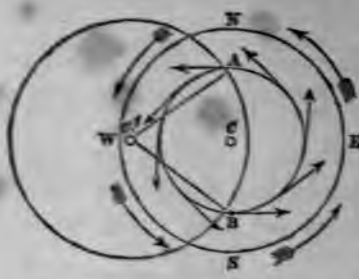
t will be observed that the wind is here spoken of as nging in a direction contrary to that of the storms them-es, which in north latitudes has been stated to be

E., and in south latitudes W. E.; for,

he first case given above, the shifts of wind are assumed occur in the direction W. E.; and, in the

ond case, in the direction W. E. In the first e this is contrary to the rotatory motion of northerly rms, and in the second case contrary to that of southerly rms.

The reason of this will be seen if we draw a circle, W.S.E., to represent the body of a storm; with a ship ywhere within its influence, as at A. Assuming the ship be in north latitude, the cyclone will be revolving in e direction shown by the curved arrows, and the wind each quarter of the storm circle will blow in the direction own by the straight arrows; for, though it sweeps *round* e storm's axis, it may, from the small segment occupied y a ship, be represented, as far as she is concerned, as a ngent to the circle.



At A, therefore, she will have the wind from the eastward, and the centre of the storm will be eight points to the left, or south of her. If it is travelling from east to west, the first shift of wind she will experience will be from S.E.; for while moving on its course in the direction, C,C', it will be changing the bearing of its centre from the ship, which, when at C', will be S.W. of her, with the wind from the S.E. So that, though the storm is revolving in the direction W. E., the wind is shifting in the direction W. E. But if the ship, on the contrary, be in the other semicircle, say at B, she would have the wind at west, and when the centre reached C', at S.W.; consequently, the change being from west to S.W., would *coincide* with the rotatory motion of the storm.

The figure will also show why, if induced to cross the path of a hurricane with a fair wind, you will be deceived by finding it coming round against you as you enter the other semicircle.

Now, if we apply these principles to the case in point, it will be seen that at 8 P.M., 16th, the prize got the first

ane-wind, the true nature of which might have been
:tured from the atmospheric appearances, the fall of
rometer, the easterly swell (cyclones in these lati-
usually travelling from the E.N.E.), and from the
of the year (the month of February being that in
the greatest number of hurricanes occur in those
les). However, at this early stage to have failed in
reting these signs is very pardonable; and the reason
othing further occurred during the night was owing
steering a course in advance of that of the storm.
A.M., 17th, however, it was gaining on the ship, which
the wind further forward; and, on tacking, and find-
e wind increasing and veering in the order to be
ted, they should have been on the alert, have care-
vatched the barometer, registering it every half-hour
een prepared to escape from the anticipated danger,
would soon unmistakably have declared itself. At
P.M., at the very latest, they should have bore up
and afterwards N.N.E., or thereabouts, as the wind
forward, and ran, until told by a rising barometer, a
ating gale, and the wind's direction that the storm
assed. By noon, 18th, they would probably have
ar enough, the wind being W.N.W., and it would
been safe to have hauled gradually round again, keep-
vay S.E. till the wind was N.W., which they would
got—say about 7 P.M., taking care not to draw too
upon the storm again, nor yet to get beyond its
nce. They might then have braced forward on the
ard tack and resumed the voyage, parallel, but in the
of the storm, with a fine, fresh breeze. Its track

...rection.

In connection with th
taken from the "Meteor
Board of Trade, will be

WIND A

"Some persons attribut
pect of weather, and say
a few days of the moon's
tween one and another p
days, and "a few" of these
phase or another. Accide
allowed to influence the mi
they mark any event more
are the prejudices against sa
to be so general.

"Continued comparisons
wind during many consecuti
the world, have proved deci

much wind (if not rain); a grey sky in the morning, fine weather; a high dawn, wind; a low dawn, fair weather.*

"Soft looking, or delicate clouds, foretell fine weather, with moderate or light breezes; hard-edged, oily-looking clouds, wind. A dark, gloomy blue sky is windy; but a light, bright blue sky indicates fine weather. Generally, the *softer* clouds look, the less wind (but perhaps more rain) may be expected; and the harder, more 'greasy,' rolled, tufted, or ragged, the stronger the coming wind will prove. Also a bright yellow sky at sunset presages wind; a pale yellow, wet; and thus, by the prevalence of red, yellow, or grey tints, the coming weather may be foretold very nearly; indeed, if aided by instruments, almost exactly.

"Small inky-looking clouds foretell rain; a light scud, driving across heavy clouds, wind and rain; but if alone, wind only.

"High upper clouds crossing the sun, moon, or stars, in a direction different from that of the lower clouds or wind then blowing, foretell a change of wind (beyond tropical latitudes).

"After fine clear weather, the first signs (in the sky) of change, are usually small, curly, streaked, or spotty clouds, followed by an overcasting of vapour that grows into cloudiness. This murky appearance, more or less oily or watery, as wind or rain will prevail, is a sure sign. The

* A high dawn is when the first streaks of morning light appear over a bank of cloud, instead of near the horizon, as is usual when there are no heavy clouds.

higher and more distant the clouds seem to be, the more gradual, but extensive, the coming change of weather will prove.

"Generally speaking, natural, quiet, delicate tints or colours, with soft, undefined forms of clouds, foretell fine weather; but gaudy, or unusual hues, with hard, definite outlines, presage rain and wind."

THE USE OF THE BAROMETER.

"By attention to the following observations (the result of many years' practice, and many persons experience), any one not accustomed to use a barometer, may do so without hesitation or real difficulty.

"In all parts of the world, towards the higher latitudes, the quicksilver ranges, or rises and falls, nearly three inches, namely, between about thirty inches and eight-tenths (30·8), and less than twenty-eight inches (28·0) on extraordinary occasions; but the usual range is from about 30·5 inches, to about 29 inches. Near the line, or in equatorial places, the range is but a few tenths, except in storms, when it sometimes falls to 27 inches.

"If the barometer has been about its ordinary height, say near thirty inches, at the sea level,* and is steady, or

* In different latitudes the ordinary, mean, or normal height may be less, or even more than 30 inches, though *seldom* the latter, except from the tropics to about the thirty-fifth parallel. It stands lower, about a tenth of an inch for each hundred feet of height directly upwards, or vertically, above the sea; when its average height, on the Thames, in England, is 29·94 inches (at 32°).

sing, while the thermometer falls, and dampness becomes * ss, north-westerly, northerly, or north-easterly wind, or as wind may be expected. †

"On the contrary, if a fall takes place, with a rising hermometer and increased dampness, wind and rain (or now) may be expected from the south-eastward, south-ard, or south-westward.

"Exceptions to these rules occur when a north-easterly ind, with wet (rain or snow), is impending, before which he barometer often rises (on account of the *direction* of

* If a thermometer have a piece of linen tied round the bulb, wetted enough to keep it damp by a thread or wick dipping into a cup of water, it will show less heat than a dry one, in proportion to the dryness of the air and quickness of drying. In very damp weather, with or *before* rain, fog, or dew, two such thermometers will be nearly alike.

Hence, for ascertaining the dryness or moisture of air, a ready and sure method is the comparison of two thermometers, one dry, the other *just* moistened and *kept so*. Cooled by evaporation, as much as the state of the air admits, the moist (or wet) bulb thermometer shows a temperature nearly equal to that of the other one, when the atmosphere is extremely damp or moist; but lower at other times in proportion to the dryness of air, and consequent evaporation, as far as twelve or fifteen degrees in England, twenty, or even more, elsewhere. About six degrees of difference is considered healthy in a temperate climate.

Pouring water over the bulb, instead of merely moistening it, imparts to the mercury the temperature of the water, which *may* be higher than that of the air.

† In the southern hemisphere, for North read South, and for South put North, in these pages.

only), a rise foretell
towards the northwa
has been low, say n
usually precedes, an
squalls) from the n
eastward, *after* which
proving weather, if
warmth continue, prob
the sun's course), an
wind will follow.

"The most dangerou
northerly* gales happen
a very low point.

"It may be repeate
changes of weather, and
are shown less by the h
by its falling or rising.
inches or upwards (at th
fine weather and modera

"A rapid rise of

ather. A slow rise or steadiness, with dryness, shows r weather.

"A considerable and rapid fall is a sign of stormy ather and rain. Alternate rising and sinking show very ettled weather.

"The greatest depressions of the barometer are with ds from the S.E., southward, or S.W.; the greatest vations with winds from the N.W., northward, or N.E.

"Although the barometer generally falls with a southerly, d rises with a northerly wind, the contrary *sometimes* curs; in which cases the southerly wind is dry and the ather fine, or the northerly wind is wet and violent.

"When the barometer sinks considerably, high wind, n, or snow will follow. The wind will be from the rthward, if the thermometer is low (for the season) from e southward, if the thermometer is high, for the time of ar and the locality.

"Sudden falls of the barometer, with a westerly wind, e sometimes followed by violent storms from N.W. or rth.

"If a gale sets in from the eastward or S.E., and the nd veers by the south, the barometer will continue fall- g until the wind becomes S.W., when a comparative lull ay occur; after which the gale will be renewed; and the fting of the wind towards the N.W. will be indicated by fall of the thermometer, as well as a rise of the barometer.

"As a general rule, the wind usually veers, shifts, or es round, *with the sun* (right-handed in northern places,

left-handed in the southern parts of the world), an
it does not do so, or backs, more wind or bad
may be expected, instead of improvement.

"This veering of the winds is a direct consequ
the earth's rotation, and currents of air from th
regions alternating or contending with others fr
equator. The polar currents are cold, dry, and
Those from the equatorial parts of the world are
moist, and comparatively light. Their alternate o
bined action (*foretold* by the glasses and other
solar heat, and electricity, cause all the varieties of w
that we experience.

"In a barometer the mercury begins to rise occasi
before the conclusion of a gale, sometimes even
commencement, as the equilibrium of the atmos
begins to be restored. Although the mercury falls
ers before high winds, it frequently sinks consid
before heavy rain. The barometer falls, but *not a*
on the approach of thunder and lightning, or wh
atmosphere is highly charged with electricity. Befor
during the earlier or middle part of severe and s
weather, the mercury commonly stands high and i
tionary.

"Instances of fine weather, with a low glass, occ
ceptionally; but they are always preludes to a durati
wind or rain, *if not both*.

"There may be heavy rains or violent winds be
the horizon, and the view of an observer, by which
instruments may be affected considerably, although

ticular change of weather occurs in his immediate
ity.

"The caution already given should be specially remem-
d, that the longer a change of wind or weather is fore-
by the barometer before it takes place, the longer the
ged weather will last; and, conversely, the shorter
warning, the less time, whatever causes the warning,
ther wind or a fall of rain or snow, will continue.

"The tides are affected by atmospheric pressure, so
that a rise of one inch in the barometer will have a
esponding fall in the tides of nine to sixteen inches,
y one foot for each inch.

"Vessels sometimes enter docks, or even harbours,
e they have scarcely a foot of water more than their
ght; and as docking, as well as launching large ships,
ires a close calculation of height of water, the state of
barometer becomes of additional importance on such
sions."

TABLE SHOWING THE FORCE AND VELOCITY OF THE
BY SIR W. SNOW HARRIS.

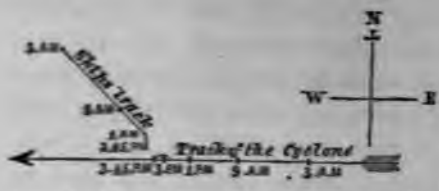
Pressure in lbs. per Sq. Foot.	Velocity in Miles per Hour.	Popular Descriptions.	Pressure in lbs. per Sq. Foot.	Velocity in Miles per Hour.	Popular Descrip
0·002	0·68	Gentle airs (unappreciable by gauge).	1·042	15	Fresh top-gallan and royals
0·004	1		1·170	16	
0·005	1·06		1·250	16·5	
0·019	2	Light airs (just appreciable by gauge); would fill the lightest sail of a yacht.	1·302	17	Fresh reefs.
0·028	2·5		1·430	17·8	
0·032	2·66		1·470	18	
0·043	3		1·563	18·67	Strong treble reef topsails.
0·052	3·3	Light breezes; such as would fill the lightest sails of a large ship.	1·630	19	
0·065	3·8		1·790	20	
0·071	4		1·820	20·14	Gales; reefed and courses.
0·090	4·5		2·084	21·47	
0·100	4·75		2·600	24	
0·112	5		3·126	26·40	
0·130	5·38		3·647	28·52	Strong close-reefe sails, and sails.
0·136	5·5		4·168	30·56	
0·162	6		4·689	32·34	
0·228	7		5·200	34	
0·260	7·6		7·800	41	Heavy gal
0·291	8	Moderate breezes, in which ships can carry all sail.	10·400	48·2	storms.
0·364	9		13·000	53·91	
0·390	9·27		15·600	59	
0·452	10		20·800	68·18	Very gales;
0·521	10·77		26·000	76·18	storms;
0·551	11		31·200	83·6	pests.
0·650	12		36·400	90·12	Tornadoes clones;
0·780	13	Fresh breezes, top-gallant sails and royals.	41·600	90·34	canes.
0·830	13·6		52·000	107·7	
0·884	14		62·400	120	
0·910	14·25				

335. THE LAWS OF STORMS (*continued*).—In this
had the subjects of it, as late as 9 A.M., when t
apprehensions were first awakened, shortened sail, brou
to on the starboard tack, and made the necessary prep

as for a heavy gale of wind, which they still would have d, they would have escaped uninjured. The centre of would have approached as near to them as it subsequently was about 1 P.M.; and then, gradually receding, ould have allowed them to proceed on their voyage. stead of which, lured on by the prospect of a good run the southward, and entertaining the erroneous idea that ning before it was the most likely means of running out f it, they hit upon the most direct method for running adlong into it, which they accordingly did, and, as we ve seen, narrowly escaped with their dismasted ship.

This being an example of a cyclone in north latitudes, 3 A.M., therefore, if the ship was within its influence, e centre must have bore E.S.E., or eight points to the t of the wind; consequently the course steered, S.E., nded to lead her directly for it, if, as was afterwards oved to be the case, the track of the cyclone, in conformity with their usual course in these latitudes, was to e westward; and the fallacy of running *from it*, as they pposed, is fully evident.

There having been little difference between the progressive motion of the storm and the speed of the ship, no considerable alteration in its bearing occured until 1 P.M., when the wind, having come round to N.E. by N., showed the bearing of its centre to be S.E. by E. As they closed, these changes necessarily occurred more rapidly; and hence the danger, when on the wrong tack, of being taken aback, as they in this instance were.



In the
ing, the
having
round to
southw
showed th
storm had passed away to the westward, and that no f
mischief was to be apprehended from this formidable m

336. SHIPS CLOSING IN A CALM.—Send the bo
both ships to the smaller, or to the one whose head
the best direction.

337. TO ASCERTAIN THE ANGLE OF THE YAR
Paste on a looking-glass a paper semicircle with the de
marked. Draw a fore-and-aft line along the deck;
place the side of the semicircle, under the yard; an
reflection will indicate the angle.

Or, if the ship is upright, you may ascertain i
dropping a plumb-line from two points along the
and running a line along the deck between them, w
cutting the fore-and-aft line, will denote the angl
Gunner's quadrant.

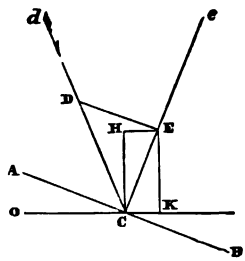
338. WHY UPPER YARDS, ON A WIND, BEAR BRA
IN ABAFT THE LOWER YARDS.—The smaller the sail
more taut it can be set, and the less belly is given t
in consequence; therefore the plane of such sails ma
larger angle, when the angles of the yards are equal.

339. THE AFTER YARDS BRACE UP SHARPER TH
THE HEAD YARDS.—And they "touch" together, beca

eddy wind, out of the sails on the foremast, striking after sails, renders it necessary that they should be ced sharper up in order to receive the true wind less iquely.

340. STRAIN ON A WEATHER BRACE.—On first strik- the sail, a current of air presses with equal force on parts of the surface; but the moment it meets with the tance offered by the sail, it escapes by passing away leeward; and this stream passing off the weather side the sail, neutralizes the direct effect of the wind to lee- rd, and so relieves the lee yard-arm.

341. WHY A SHIP GOES TO RWARD.—Let AB represent one the yards of a ship that is close- aled. C*d* the direction, and CD e force of the wind; CE the ective force of the wind upon the l (=CD × cos. DCE), commu- ated in the direction C*e*, perpen- ular to its surface.



Resolve the force CE into its equivalents CK, CH (the e in the direction of the keel, and the other perpendicu- it), and the former will represent the force exerted to ve the ship ahead in the direction CO, and the latter set her to leeward.

The direct force is equal to the lateral force when the wind will admit of the yard being trimmed at an angle of 45° with the keel; but it will decrease as the yard is aced forward to that point.

The ship is forced ahead—notwithstanding t
of lateral force, because the resistance offered b
is so much less than that presented by the
Evidently therefore (leaving leeway out of consi
as a ship will sail at a less angle to the wind
points, she will, on each tack, go to windward
drawn from her position at right angles to the
by thus working, will actually approach the qu
whence the wind is blowing.

342. FORE CHAINS CARRIED AWAY, AND CHA
DAMAGED.—Set the rigging up with luffs to th
the ship's side, placed there for that purpose; tw
a shroud. Replace what chain-plates require it
ones, and keep them out in their place with a
wood between them and the ship's side; the
rigging up properly.

343. GETTING QUARTER AND STERN BOATS IN-
Quarter boat. Wooden davits. Run the sail-tac
the main topmast head, abaft the mast, and hook
foremost slings; haul taut, take the weight of
and come up the fall. Hook an up-and-down
mizen-mast head to the foremost davit, pull up, k
bolt out, unship the davit, and then fleet the up-
to the after slings. Pull up the sail-tackle an
bows of the boat in, clear of the backstays; the
the up-and-down, overhaul the after fall, unhook
in-board, and transport the boat where you please

Stern boat. Shift one of the boom topping-lift

ould be fitted to unhook), to the boom end, top it well
, and hook a burton and a jigger to a strop on the end
the boom. Sling the boat a little before the centre,
d hook the burton. To the bolt in the stern hook the
gger. Haul both taut and unhook the falls; lower the
gger, cant the stern of the boat out, and the bows in;
en pull up on the burton, haul forward on the painter,
d get the bows in on the rail; pull up on the jigger,
ght to the burton, and lift her in on the deck.

A cover laced over a boat will prevent her filling, when
in danger of being washed away, and you are unable to
op her up or get her inboard.

344. PREPARE FOR ACTION.—Have steam ready for
ll speed, unbend sails, get top-gallant masts on deck,
nd down studding-sail booms, top-gallant rigging, and as
uch running gear as possible; get the topsail yards and
izen topmast on deck. House the fore and main top-
asts, rack the top tackle pendants and unreeve the falls;
sh the heads and heels of the topmasts to the lower
ast, that they may help to support it if wounded; run
in jib-boom and bowsprit if so fitted; it would also be
dvisable, I think, if the weather will permit, to clear away
some of the lanyards of the lower rigging, and have every-
thing clear for cutting away the lanyards left secured.

Brace the lower yards sharp up, and hang them, also
ake any other precaution that may suggest itself to you,
in order to ensure the masts, if they should unfortunately
be shot away, going clear of the ship at once, instead of
falling alongside, masking your guns, or worse still fouling

the screw, the very life of the ship, and without which you must fall an easy victim to the ram or guns of your opponent. If the sails cannot be stowed away below, they should be well wetted, and rolled taut up. Boats' davits should be topped and secured; spare wheel ropes rove, relieving tackles in readiness, rudder pendants cut adrift, and led in-board; yards and stays ready for hoisting out boats. Before commencing an action, decks should be wetted and sanded; bulkheads triced up, tubs of water distributed about the decks, pumps tried, hoses screwed on to the steam main, and every possible preparation made against fire.

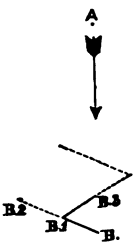
The unrove running rigging may be worked into rope mantlets, which, when hung up to the ship's side between the guns, prove a most effective protection from splinters, small fragments of iron, &c.

345. ENGAGING AN ENEMY.—No positive rule can be laid down, as so much must depend upon circumstances, and the nature of the opposing ships. But this may be said, that the windward position allows better pointing and the smoke clears off instead of blowing into the ports. In ironclads, especially turret ships, the more oblique angle of side you can expose to the shot of your enemy, while keeping your own guns bearing, the greater will be the defensive power of your plating, and the more favorable position will you be in, should a chance of using the ram occur, while your rudder and screw are safe from injury if you attack in this manner bow on.

346. CHASING TO WINDWARD.—Work up, as close as

ible, in a line dead to leeward of the chase, because, longer you stand on beyond this, the better you will n the other tack (and consequently are doing so much worse on the present tack). Therefore, tack as frently as you can on either side of that bearing from the e which coincides with the direction of the wind.

et A represent the chase at noon, ten miles dead to iward of the chaser B.



1. The position of the chaser, at the rate our miles an hour, when she tacked at o P.M.

3. Her position at 1 P.M., and

2. Her position at the same time, supng her to have stood on (under a popumotion), until she had brought the chase am.

low, from B^1 the chase bears N. by E. seven points a the course the chaser is lying. The latter consently tacks, and lies up on a course five points off the se, which, of course, is better than standing on as she . Supposing, however, that she ignorantly stands on il she brings the chase abeam B^2, and the chase also ks, her position then would be a mile further from the se than if she had tacked earlier, for she would then, has been shown, have been at B^3, steadily following chase up without giving her a chance of escape.

347. On the Chaser tacking when she can fetch the Chase.—Whether the chase should tack, also, deends upon whether the chaser is astern of her, or on the

bow; if on the lee bow, the chase should tack als
if she stood on, she would close her pursuer unti
met, if the chase tacked at a proper time. But, if c
up astern, she should stand on, for, were she to tac
would near the chaser until she arrived in the wind
of her, when any shift of wind whatever would be
to her advantage. In either case *the chase should k*
the same tack as the chaser, who then only by su
sailing will be enabled to close.

348.—CHASING TO LEEWARD OR A STEAMER.—
by a rough guess, the course that you think will
you to intercept the chase, and take her bearing.
find that she is heading you, it shows that you hav
away too much, and should haul up a little; l
dropping, you may edge away a little more. Conseq
the direct course, for the point at which you would
will be that on which her bearing remains the same,
her course not be altered, or your relative rates of
vary. She should be closely watched; and if she
her course, you must at once adopt a fresh one.

If the chase sail better than ships in general wit
wind abeam, quarterly, aft, or on a wind, as the cas
be, she should be ready to take advantage of it, if
is any considerable distance between you, by gra
bringing you on that bearing which will enable h
steer directly from you on that particular point of s
she has an advantage in. If, however, she has
choice in that respect, she should endeavour to gain gr
by watching her pursuer narrowly, and gradually alt

ɔurse when she observes that she has hit off the r bearing.

. How Grenville fought the Spaniard.—"In it, 1591, Lord Thomas Howard, with six English -battle ships, six victuallers, and two or three pin- were lying at anchor under the islands of Florez. in ballast, and short of water, with half their men ed by sickness, they were surrounded by a Spanish f 53 ships. Eleven out of the twelve English ships d the signal of the admiral, to cut or weigh their rs, and escape as they might. The twelfth, the nge,' commanded by Sir Richard Grenville, of rd, was unable for the moment to follow, of her of 190, ninety being sick on shore, and, from the n of the ship, there being some delay and difficulty ting them on board. But Sir Richard was in no to fly. He first saw all his sick on board and stowed on the ballast, and then, with no more than 100 men m to fight and work the ship, he deliberately weighed, ain, as it seemed at first, what he intended to do. panish fleet were by this time on his weather bow, e was persuaded (we here take his cousin Raleigh's ful narrative and follow it in his words), to cut his ail and cast about, and trust to the sailing of the

but Sir Richard utterly refused to turn from the y, alleging that he would rather choose to die than to nour himself, his country, and her Majesty's ship, per- ing his company that he would pass through their two

squadrons in despite of them, and enforce those of Seville to give him way; which he performed upon divers of the foremost, who, as the mariners term it, sprang their luff and fell under the lee of the 'Revenge.'

"The wind was light; the 'San Philip,' 'a huge high-carged ship, of 1,500 tons, came up to windward of him, and taking the wind out of his sails, ran aboard him. The Spanish ships were filled with soldiers, in some 200, besides the mariners; in some 500, in others 800. * * * * After many interchanged volleys of great ordnance and small shot, the Spaniards deliberated to enter the 'Revenge,' and made divers attempts hoping to force her by the multitude of their armed soldiers and musketeers; but were still repulsed again and again, and at all times beaten back into their own ship or into the sea.'

"All that August night the fight continued, the stars rolling over in their sad majesty, but unseen through the sulphur clouds which hung over the scene. Ship after ship of the Spaniards came on upon the 'Revenge,' 'so that never less than two mighty galleons were at her side and aboard her. Before morning fifteen several armadoes had assailed her, and all in vain; some had been sunk at her side; and the rest, so ill approving of their entertainment, that at break of day they were far more willing to hearken to a composition, than hastily to make any more assaults or entries.'

"All the powder in the 'Revenge,' was now spent, all her pikes were broken, forty out of her 100 men killed, and a great number of the rest wounded. Sir Richard,

h badly hurt early in the battle, never forsook the till an hour before midnight; and was then shot gh the body while his wounds were being dressed, gain in the head, and his surgeon was killed while ling on him. The masts were lying over the side, gging cut or broken, the upper works all shot in , and the ship herself, unable to move, was settling in the sea; the vast fleet of Spaniards lying round a ring, like dogs round a dying lion, and wary of aching him in his last agony. Sir Richard seeing was past hope, having fought for fifteen hours, and ng, by estimation, eight hundred shot of great ry through him, commanded the master-gunner, he knew to be a most resolute man, to split and he ship, that thereby nothing might remain of glory tory to the Spaniards; seeing in so many hours they not able to take her, having had above fifteen hours above ten thousand men, and fifty-three men-of-war rform it withal, and persuaded the company, or as as he could induce, to yield themselves unto God to the mercy of none else; but as they had, like it resolute men, repulsed so many enemies, they d not now shorten the honour of their nation by nging their own lives for a few hours or a few days.' The gunner and a few others consented. But such ἀνὴρ ἀρετὴ was more than could be expected of ary seamen. They had dared do all which did become and they were not more than men, at least than men then. Two Spanish ships had gone down, above n hundred men were killed, and the Spanish admiral

could not induce any one of the rest of his fleet t
the 'Revenge' again, 'doubting lest Richard woul
blown up himself and them, knowing his dangero
position'! Sir Richard lying disabled below, the
finding the Spaniards as ready to entertain a comp
as they could be to offer it, gained over the majo
the surviving crew; and the remainder then drawi
from the master-gunner, they all, without further
ing their dying commander, surrendered on hon
terms; 'the ship being marvellous unsavourie,' Alo
Bacon, the Spanish admiral, sent his boat to br
Richard on board his own vessel. Sir Richard,
life was fast ebbing away, replied that 'he might d
his body what he list, for that he esteemed it not;'
he was carried out of the ship, he swooned, and re
again, desired the company to pray for him. In
hours, Sir Richard, finding his end approaching, s
not any sign of faintness, but spoke these words in Sp
and said, 'Here die I, Richard Grenville, with a
and quiet mind, for that I have ended my life as
soldier ought to do that hath fought for his country,
religion, and honour. Whereby my soul most jo
departeth out of this body, and shall always leave b
it an everlasting fame of a valiant and true soldier
has done his duty as he was bound to do.' When h
finished these, or other such-like words, he gave u
ghost with great and stout courage, and no man
perceive any sign of heaviness in him.

"Such was the fight at Florez, in that August of
without its equal in such of the annals of mankind a

ng which we call history has preserved to us. At the e, all England and all the world rang with it. It struck eeper terror, though it was but the action of a single p, into the hearts of the Spanish people; it dealt a more idly blow upon their fame and naval strength than the truction of the Armada itself; and, in the direct results ich arose from it, it was scarcely less disastrous to them. ndly, as it seems to us, if the most glorious actions ich are set like jewels in the history of mankind are ighed one against the other in the balance,—hardly will ne three hundred Spartans, who, in the summer morning, e 'combing their long hair—for death,' in the passes of ermopylæ, have earned a more lofty estimate for themves than this one crew of modern Englishmen.

"After the action there ensued 'a tempest so terrible, was never seen or heard the like before.' A fleet of rchantmen joined the armada immediately after the ttle, forming, in all, 140 sail; and of these 140, only 32 r saw Spanish harbour. The rest all foundered, or re lost on the Azores. The men-of-war had been so ttered by shot as to be unable to carry sail; and the evenge' herself, disdaining to survive her commander, as if to complete his own last baffled purpose, like nson, buried herself and her 200 prize crew under the ks of St. Michael's."*

After reading this, each man's feelings will be the best nment; but, if his patriotism be not stimulated, his tives purified, and his spirit fired by such an example, is not to be envied; for it stands alone, even among

* England's forgotten worthies.— *Westminster Review.*

those marvellous exploits—

"That fill
The spacious times of great Elizabeth
With sounds that echo still."

WITH A SQUADRON.

350. IN OPEN ORDER.—The ships will be four; and in "Close Order," two cables apart.

351. COLUMNS APART.—The distance should be twice the number of ships in the longest column in cable's lengths; thus, with four ships in line, the columns would be eight cables apart; but cruising in "Open Order," ten cables is the distance usually preserved.

352. FLEET NUMBERS.—A number is given by the Admiral to each ship, it indicates her station in column. The fleet is also divided into divisions and sub-divisions.

353. COLUMNS OF DIVISIONS AND SUB-DIVISIONS—Are the terms used to denote that the ships composing the fleet are formed in divisions or sub-divisions, whether in line ahead or otherwise; for instance, "Columns of Divisions in line abreast."—"Columns of Sub-divisions in quarter-line," etc.

"Columns of Divisions in line Ahead."

"Close Order."

Scale—Half-an-inch to one cable.

By altering course together eight points, the ships become formed in "Columns of Divisions in line-abreast.

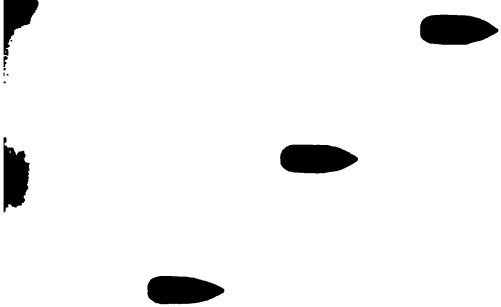
354. LINE-ABREAST.—A column is in "line-abreast" when the ships are ranged in one line abeam of each other.

"Single Column line-abreast."

Alter course eight points together, and the ships become ...ed in "Single Column line-ahead."

355. QUARTER-LINE.—A column is said to be in "quarter-line," when the ships are ranged in one line, ...aft each others beam, but not right astern.

"Column in quarter-line."

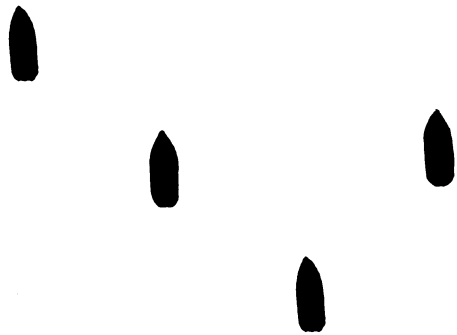


...enerally this line is formed four points abaft the beam ...he leaders.

"Column in two quarter-lines."

A column is said to be in "two quarter-lines" wh
ships are ranged on each quarter of a single ship.

"Column in two bow-lines."



A column is said to be in "two bow-lines" w
ships are ranged on each bow of a single ship.

356. DIRECTION OF A COLUMN—Is the bearing on which the ships are formed from their leaders.

357. TACKING IN SUCCESSION.—The leading ships put their helm down together, the other ships at the moment that will allow them to fetch into the wake of their next ahead when on the other tack.

358. LINE OF BEARING—In the old sense meant that the fleet were sailing on a bearing, which, if they hauled their wind, or tacked together, would put them in "line of battle," or, as it is now termed, "line-ahead." It may be generally understood to mean that ships are on a bearing from each other; into which they have been thrown by altering course together.

The following definitions of the technical terms connected with fleet sailing, may be of use to those who have not access to the general signal book, from which they are taken.

A Column means any number of ships in a distinct group, whether in line-ahead, abreast, or otherwise.

The *Leading Column* is the headmost column in any formation.

The *Starboard Wing Column* is the column on the extreme right of any formation.

The *Port Wing Column* is the column on the extreme left of any formation.

The *Rear Column* is the sternmost column in any formation.

The *Leader of a Column* is the headmost ship.

The *Starboard Wing Ship* of a column is the ship on its extreme right.

The *Port Wing Ship* of a column is the ship on its extreme left.

The *Rear Ship* of a column is the sternmost ship.

The ship *next ahead* of another, is that immediately before her, or before her beam.

The ship *next astern* of another, is that immediately behind her, or abaft her beam.

The "*Starboard Columns*" of a formation are the alternate columns, commencing from the right.

The "*Port Columns*" of a formation are the alternate columns, commencing with the second column from the right.

The foregoing terms when used in the evolutionary signals refer solely to the position of the ships at the moment of making the signal, and no ship or column is ever alluded to by a term expressive of position, unless such ship or column actually holds that position at the time.

The formation or disposition of a fleet is termed its *order*.

The term *Commander of Column* indicates the senior officer in that column.

The following remarks in connection with steam evolutions may perhaps be found of some interest to young officers who have not had much experience with large squadrons.

:ed of a fleet steering a course is limited to that
est ship.
:ed at which a fleet can manœuvre must be still
nsure the slow vessels the power of preserving
on with facility.
ren speed, the rapidity with which an evolution
a large alteration of course can be effected, will
ied by the ships of the most inferior steering

:he foregoing can be gathered the great im-
of the ships composing a fleet assimilating each
h in speed and handiness.
:e station can be best preserved by making
not extreme, changes of speed or course, which
lers the station of the ships following you most
o keep, besides increasing the expenditure of

commencing steam evolutions, each vessel should
of the revolutions of the screw per minute, re-
her to go the same speed as any other ship
olutions are known; this can be best done by
a co-efficient of revolutions.
ral comparison of the angle of helm that can be
h the diameter of the circle described, will be
st useful.
presence of an enemy, owing to the great un-
of signals being seen and correctly interpreted,
: absence of a pre-concerted plan of attack, it is
le that any but the most simple and easily exe-
nœuvre would be attempted; the more compli-

cated may be regarded rather as affording an
necessary to the attainment of skill and precision i
ling the ships, than for their elaborate performanc
face of a hostile fleet.

Smokeless coal is an absolute necessity in a fleet.

359. WEARING IN SUCCESSION.—Your ship bei
round on the other tack, the after yards should be
until the last ship in the line has passed, lest, by
to the wind too soon, you do not allow room for th
ships to pass ahead of you; whereas, with the after
well in, you are all ready for keeping away in
accident.

360. FOG AT NIGHT.—Use the fog horns, or if
steam, the steam whistle; stop all unnecessary noise
the last bearing and distance of the Admiral, and
next ahead; have a watch with second hand, and
ready to note any gun signals the Admiral may
avoid making any sudden changes of speed if possib

361. THE ADMIRAL'S MOTIONS—Should at all
be immediately followed, unless ordered to the cont

362. TRIAL OF SAILING.—To ascertain the result
assume your own ship throughout the trial to be a
point, and lay off from it, at the commencement an
of the trial, the bearing and distance of the ship or
with whom you are competing. The bearing is obt
by compass; and the distance is deduced from the
head angle, the height of the mast-head being previ
ascertained.

[redacted]

[redacted]

[redacted]

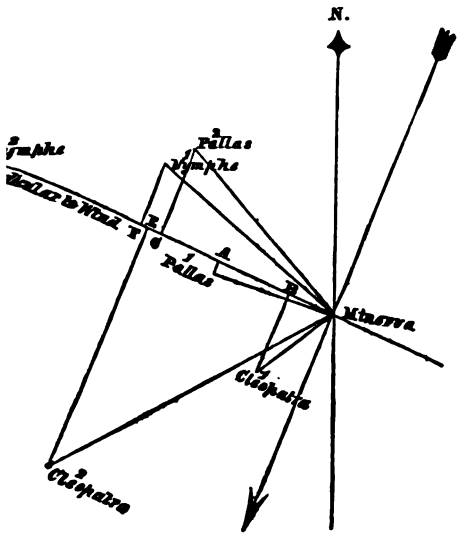
take occuring or accident happening to any particular ship, you may, on subsequent consideration, find it judicious to close her part in the trial at one of the intermediate hours, which you have therefore an opportunity of doing.

In taking angles, the mast-head should be brought down to a point level with the observer's eye, otherwise the angle at the base is more, or less, than a right-angle. Consequently, the angle subtended by the mast-head and hammock-netting, when the observer is on the deck of his own ship, is more correct than that between the mast-head and water-line. The distance, moreover, between the latter is not a constant number, being affected by the distance the ship is from you.

SAILING TRIALS.

hips.	Bearings.	Angles.	Wind.	Remarks.
llas	N. 73° W.	2° 40'	N.N.E.	10h. 15m. Tacked together.
mphe	N. 49 W.	2 10		10h. 20m. Cleopatra unable to carry royals.
opatra	S. 55 W.			
llas	N. 40 W.	1 35	„	Steady breeze throughout.—Rate of sailing, 5½ to 6 knots.
mphe	N. 67 W.	0 46		
opatra	S. 62 W.	0 52		

Height of mast-heads.... { Pallas.....167 feet. Nymphe ....140 „ Cleopatra ..140 „



"PALLAS."

Positions at 8 A.M.		Positions at 11 A.M.
167 feet and ∠ 2° 40′ gives $MP^1 = 597$ fathoms		167 feet and ∠ 1° 35′ gives $MP^2 = 1009$ fathoms
NMA $(90° - 22\frac{1}{2}°) = 67\frac{1}{2}°$	$AP^1 = MP^1 \times \sin. AMP^1$	$NMP^2 = 40°$ ..... $GP^2 = MP^2 \times \sin. GMP^2$
NMP^2 (73°	2·775974	GMP^2 $(67\frac{1}{2}° - 40°) = 27\frac{1}{2}°$ ..... 9·664406
AMP^1 $(73° - 67\frac{1}{2}°) = 5\frac{1}{2}°$	8·981573	3·003891
57	1·757547	466 ..... 2·668297

Commencement of Trial ..... 57 fathoms to leeward of "Minerva."
End ..... 466 fathoms to windward.

Gain on "Minerva" in 3 hours .. 523 fathoms.

"NYMPHE."

$MN^1 = 1046$ fathoms ..... $FN^1 = MN^1 \times \sin. FMN^1$ $MN^2 = 1744$ fms. Deduced from mast-head angle.

$NMN^1 = 49°$	3·019532
FMN^1 $(67\frac{1}{2}° - 49°) = 18\frac{1}{2}°$	9·501476
332	2·521008

Commencement . . . . . 332 fathoms to windward.
End of Trial, equal.
Loss on "Minerva" . . . . . 332 fathoms.

"CLEOPATRA."

$MC^1 = 445$ fathoms ..... $BC^1 = MC^1 \times \sin. BMC^1$ $MC^2 = 1542$ fathoms. $EC^2 = MC^2 \times \sin. EMC^2$

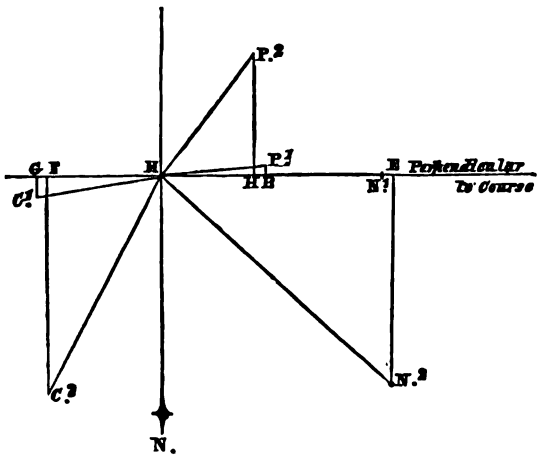
	2·648360		3·188084
BMC^1 $(180° - \overline{55° + 67\frac{1}{2}°}) = 57\frac{1}{2}°$ ...	9·926029	EMC^2 $(180° - \overline{62° + 67\frac{1}{2}°}) = 50\frac{1}{2}°$	9·887406
375	2·574389	1190	3·075490

Commencement of Trial . . . . . 375 fathoms to leeward of "Minerva."
End . . . . . 1190 fathoms "

OFF THE WIND.

illustrate a trial of this description, let it be assumed
ı the afternoon the same ships took up position east
est of the "Pallas," and when, at 1.30 P.M., all were
started under all sail, that the bearings and angles
nal were taken; were repeated at 2.30, and again

Ships.	Bearings.	Angles.	Course.	Wind.	Remarks.
Pallas	S. 85° W.	5° 54'	South	North	All ships carried studding-sails both sides
Nymphe ..	West	2 20	7·5 knots	6, b. c.	
Cleopatra	N. 81 E.	4 30			
Pallas	S. 39 W.	4 15			3 P.M. "Cleopetra" carried away part fore topmast studd.-sail boom; 3·20 sail set again
Nymphe ..	N. 47 W.	1 50			
Cleopatra.	N. 29 E.	2 18			



POSITIONS at 1·30 P.M. "PALLAS." POSITIONS at 4 P.M.

$MP^1 = 250$ fms. $BMP^1 = 5°$ $BP^1 = MP^1 \times \sin. BMP^1$ $MP^2 = 366$ fms. $HMP^2 = 51°$ $HP^2 = MP^2 \times \sin. HMP^2$

	2·397940			2·563481	
	8·940296			9·890503	
22	1·338236		284	2·453984	

Commencement of Trial.....22 fathoms ahead of "Minerva."
End ..... 284 fathoms "

Gained on "Minerva" .....262 fathoms.

"NYMPHE."

$MN^2 = 729$ fms. $EMN^2 = 43°$ $EN^2 = MN^2 \times \sin. EMN^2$

				2·862727	
				9·833783	
			497	2·696510	

At commencement of Trial .....abeam of "Minerva."
At conclusion .....497 fathoms astern.
Therefore "Minerva" beat her that distance.

"CLEOPATRA."

$MC^1 = 296$ fms. $GMC^1 = 9°$ $GC^1 = MC^1 \times \sin. GMC^1$ $MC^2 = 581$ fms. $FMC^2 = 61°$ $FC^2 = MC^2 \times \sin. FMC^2$

	2·471292			2·464176	
	9·194332			9·941819	
46	1·665624		508	2·705995	

At starting.....46 fathoms astern of "Minerva."
At close.....508 fathoms "

ıen the trial closed; and that the following
were made by the "Minerva." (The inter-
s are not noticed.)
las,' therefore, proved herself the best ship on
of sailing; the "Minerva" second; and, of
two, the "Nymphe" best on a wind, and
" before it.

SAIL-YARD SPRUNG IN A TRIAL.—Fish it tem-
a couple of capstan bars.

N TOPSAIL SPLIT ACROSS THE HEAD.—Take

'PERING THE LEECH OF A TOPSAIL.—Settle
, cut a piece of rope long enough to connect
the leech-rope, work a knot in each end, send
ı in a bowline, and pass a seizing round the
ıder each knot.

NSTAYS CARRIED AWAY.—Bear up, trice up
tackles, then haul your wind.

DER DISABLED.—Veer something astern by a
ł a couple of guys to the hawser, and lead
h a block on each quarter, rigged out if you
nd get a tackle on in-board. Veer the bend
nce astern; and, to port the helm, haul in on
ł guy, easing the port, and *vice versâ*.
ıer circumstances, the end of the hemp sheet-
may be used.

250

which was lowest, and in the southern hemisphere which was held uppermost. The sun by day and ars by night are the only other guides you have.

Captain Golowin's narrative of his captivity in Japan, 11—13, he relates how they imparted magnetism to needle by rubbing it with a stone. "The proverb necessity is the mother of invention," he observes, fully realized; for Mr. Chlebnikoff even managed to a compass. We requested our attendants to let us two large needles for mending our clothes, and after- s pretended that we had lost them. The Japanese times fasten together the beams of their houses with er; this had been done in our house, although the er was very rusty. Mr. Chlebnikoff cleaned a piece is copper, in the middle of which he bored a hole, so a needle might be placed upon it. By frequently ing this needle on a stone. which he selected for the ose, he succeeded in magnetising it, and finally gave ch a degree of polarity, that it pointed, with tolerable racy, towards the north."

11. NECKLACE ON THE FOREMAST CARRIED AWAY.— able to stand on the other tack, lower the topsail, a hawser up to the topmast head, pass it round, pay n, hook the single blocks of a couple of luffs to bolts e chains, bring to, snatch the falls, set the hawser up, seize both parts together below the cross-trees. If breeze is fresh, get a sail-tackle up in addition.

f unable to replace or repair the necklace, either fit a e one, or bring together all the futtock shrouds that re-

quire securing, shackle them to a spare anchor-shackle or otherwise, and set them up with a couple of up-and-downs hooked at the partners, and then frap them in to the mast aloft. The spurs through the links will hold the necklace on the opposite side to where it is carried away; and it is not probable, either, that both necklaces on the mast will carry away at the same time.

372. Taking in Boom Mainsail.—In lowering away, mind and keep the jaws below the peak, or you will not get the sail down.

373. Stowage of Boom Mainsail.—Pass the leech along the gaff, taut in from the gaff and boom ends, with the exception of a foot or two of slack, which the outer hand keeps back for a skin to stow the foremost part of the clew in, close under the gaff end: the slack sail is then passed forward, gathered up and stowed in the head cloths. When the gaskets are passed, the gaff is lowered with the sail just touching the boom.

A cutter's mainsail is frequently stowed on the foot.

374. Trimming Sails, short-handed.—If the wind draws aft, trim the after yards first; if forward, the head yards.

375. Reefing Topsails in Stays.—According to the old song, you

"Away aloft" when the helm is put down;
"Lower away the the topsails," as the main yard flies round;
"Trice up," and "lay out," and take two reefs in one;—

For all in one moment this work must be done.
Then, man your head braces, your halyards, and all,
And as you "hoist away the topsails" you "let go and haul."

But a better plan is to "lower the topsails" when you raise tacks and sheets," laying the yard square. Haul the main yard at the proper time, regardless of the men on the yard, provided the topsail braces are kept taut. Take the reefs in properly, "hoist the topsails" when the men are off the yards, and "haul of all" as usual.

The watch on deck and idlers reef the topsails, and watch below put the ship about.

376. MAN OVERBOARD.—*Plain sail, on a wind.*—Let go the life-buoy, put the helm a-lee, call the boat away, and direct the signalman not to lose sight of the man. Bring the ship up into the wind, to deaden her way (taking care not to bring her round or to give her sternway), square the main yard, haul the mainsail up, and shorten whatever sail is necessary. The practice of going about, under these circumstances, is in many respects very objectionable. The cry of "man overboard!" in the most perfectly disciplined ship, is sure to be attended with some confusion at first, which becomes "worse confounded" when followed by the pipe of "hands about ship!" repeated and spun out by half a dozen boatswain's-mates. How much more quiet and simple is the order "square the main yard!" But the great and conclusive objection to it is, that, ten to one, the cause of it all will be lost sight of—in the literal sense; and, after getting the ship round and lowering the boat, *then* will arise the

mean time is prob
what with the haili
in the end is prett
contrast does heavi
un-embarrassed by
to distract his attent
a point wide, a flag
At all times at night,
the life-buoy not b
with still greater forc

It may be urged, th
to windward of the n
therefore, she will reac
the ship hove to on th
she does reach to
(although the main yar
gain? Though the b
must not be assumed
about, her boat must p
falls from the ship an

Main sail, before the wind.—Put the helm over, and me to the wind with the head yards aback, hauling up foresail, and setting the spanker.

Studding-sails on one side.—Put the helm-a-lee, trip up lower studding-sail, or let go the outer halyards, let studding-sail tacks, brace up the after yards, and her to the wind with the head yards square. The ding-sails will fly before all, where they will be be- ed, and must be hauled down principally by the deck s. If you put the helm up to take the studding-sails leeward, you run a most unnecessary distance away the man; whereas, even in a fresh breeze, you run sk by letting fly the tack of a weather studding-sail, the sail flies to leeward clear of everything.

Studding-sails, both sides.—Round to with all despatch, in this case you must take everything in properly; if you let fly tacks and so forth, before the controlling can be manned, you will find "the more haste" to "the less speed.

In each of the above cases, both quarter-boats, when ible, ought to be cleared away and lowered as speedily possible, and the life-buoy let go instantly, except in a y light breeze and when the man falls from forward, en you should hold on a little to come up to him, and n let go. Beware, too, of committing a blunder, which once saw nearly perpetrated, of dropping the buoy on the man's head.

Cases are not uncommon of men being drowned after ey have been seen to get hold of the life-buoy; and, as

on two occasions, I have seen it turn over with a m
is very probable that to that cause such accident
owing—the man being in an exhausted state and u
to get hold again. The proper way to hold on, is t
the feet on the rest at the bottom, one on each side,
throw the arms over the cross-piece; whereas an att
to get *on* it will result in a capsize.

The circular cork life-buoys are so handy for *thro*
to a man, that is well worth while to carry one on e
quarter for that purpose.

Boat's gripes, instead of being secured to an eye-bol
the chains, should be set up to a strop with a thimbl
it. passed through the eye-bolt, and retained thereby b
slip-toggle a lanyard attached; which has therefore me
to be hauled upon to free the boat.

The steadying-lines should be of chain, with a hook
the ends; rope ones give, and are seldom hitched squ
If they are too taut, an undue strain is brought upon
gunwale; and if too slack, the boat is not steadied.

To hoist a quarter boat up in a sea-way, there is
combination of "gil-guys" that you can invent equal
jackstays from the davits, set up to bolts at the water-li
A lizard is fitted to each, which travels up and down
turn whipped round the thwarts, and the boat run
clear of the side, without further ado.

377. TREATMENT OF A MAN APPARENTLY DROWNED.—
The following directions are those issued by the Ro
National Life Boat Institution:—

the patient instantly, on the spot, in the open
the face and chest to the breeze, (except in
r.)

"*To clear the Throat.*

the patient gently face downwards, with one
ıe forehead, in which position all fluid will
mouth, and the tongue itself will fall for-
ş the entrance into the wind-pipe free; assist
by wiping and cleansing the mouth.

ıe breathing—wait and watch; if there be no
if it fail, then—

"*To excite Respiration.*

the patient well and instantly on the side,

the nostrils with snuff, hartshorn, volatile
throat with a feather, &c., and dash cold
face previously rubbed warm.

ɔe no success, lose not a moment, but in-

"*To imitate Respiration.*

ɛ the patient on the face, raising and sup-
ıest well on a folded coat or other article of

the body gently on the side and a little
then briskly on the face, alternately; repeat-
ɛasures deliberately, efficiently, and perse-

veringly, about fifteen times in the minute, or every four seconds, occasionally varying the side."

[*By placing the patient on the chest, it is compressed by the weight of the body,* expiration *takes places; when turned on the side, this pressure is removed, and* inspiration *occurs.*]

"7. On each occasion that the body is replaced on the face, make uniform but efficient pressure, with brisk movement, on the back, between and below the shoulder-blades or bones on each side, removing the pressure immediately before turning the body on the side."

[*The first measure increases the expiration, the second commences inspiration,*]

*** The result is—respiration, or natural breathing—and, if not too late, life.

"8. After respiration has been restored, promote the warmth of the body by the application of hot flannels, bottles or bladders of hot water, heated bricks, &c., to the pit of the stomach, the arm-pits, between the thighs, and to the soles of the feet.

"*To induce Circulation and Warmth.*

"9. During the whole time do not cease to rub the limbs upwards with firm, grasping pressure, and with energy, using handkerchiefs, flannels, &c."

[*By this manner the blood is propelled along the veins towards the heart.*]

"10. Let the limbs be thus warmed and dried, and then clothed, the bystanders supplying the requisite garments.

" Cautions.

nd quickly for me-
sistance, and for
ving.
void all rough us-
turning the body
ack.
nder no circum-
hold up the body
eet;
or roll the body
;;

" 5. Nor rub the body with salts or spirits.

" 6. Nor inject tobacco-smoke or infusion of tobacco.

" 7. Avoid the continuous warm bath.

" 8. Be particularly carefull to prevent persons crowding round the body.

" General Observations.

the restoration of life, a teaspoonful of warm ould be given, and then, if the power of swallow- : returned, small quantities of wine, or brandy and arm, or coffee. The patient should be kept in bed, sposition to sleep encouraged.

treatment recommended should be persevered in nsiderable time, as it is an erroneous opinion that are irrecoverable because life does not soon make arance, cases having been successfully treated after ing several hours."

LETTING GO LIFE-BUOY.—As you face aft, the nd fires, and the left lets go.

TOPMAST SHATTERED BY LIGHTNING.—Lash a light each side of the mast, and unfid. Cut away these

spars as you lower, lashing the topmast to the standing part of the hawser as it comes below the cap.

(I see that this wrinkle is already before the naval world in Captain Liardets work; but, as I heard of it several years previously, it is doubtless public property.)

380. TOPSAIL ON FIRE.—*Fore Topsail.*—Bear up, haul down and stow the head sails, clew the topsail up, keeping it mast-headed, and cut the foresail adrift. Then lower the topsail yard, and play upon the fire with engine and fire-buckets.

Main Topsail.—Take in all sail but jib and spanker, and bring the wind abeam.

With mizen topsail on fire, come to the wind.

381. MAKING UP A TOPSAIL FOR BENDING.—To bring a sail to, furled, it is, of course, indispensably necessary to lighten the yard-arms as much as possible, and, consequently, to throw all the weight you can into the bunt, which is kept up by the sail-tackle. Having, therefore stretched the head taut along the deck, roping downwards, and gathered back from the head, you bring the second reef up to it to form the skin; then lay the leech from the second reef-cringle to the reef-tackle cringle, along the head, gathering all the slack sail into the bunt; the reef-tackle bridle is left out, the cringle being brought up to the head cringle, and the clews carried in and laid out over the head on each quarter. The buntline toggles are brought in amidships, and seized to the head, so that,

ey are bent and a turn is taken with them, the
an be walked back, and the strop cut adrift.
ne toggles being left out, the foot-rope and all
gathered in amidships, the sail is rolled up and
s are passed; and the clews, of which there is
ɔle drift left out for convenience in handling
ɔassed from the fore side of the sail, underneath,
ed up on the after side. Seize the strop on, and
ead-earings in to the bunt, handy for laying hold
ɜsing out, when the sail is swayed up to the yard;
heavy sails, it may be necessary to hitch the
round the quarters, to keep them up.

AKING UP A COURSE.—Reef-tackle cringles are
to the leeches a couple of feet below the head,
he reef-tackles are hooked for hauling out when
and shifted down to their proper cringle below
hen the earing is secured.

the head taut along, gather back, and bring up
ıd reef to form the skin; bring the leech taut
n the cringle, to which the reef-tackle is to be
lay the leechlines toggles out, and seize them to
and they will thus be in their proper places, close
blocks, when the sail is hauled out; bring the
ɔggles close in amidships, drag all the slack sail
bunt, and lay the clews out like those of the
oll up, pass the gaskets, stop the head-earings up
ɜeize the strop on, and seize the head of the sail
ır part of the strop, that when the strop seizing
head of the sail may be kept up until brought to.

383. MAKING UP A JIB.—Stretch the foot of the sail along; pass a reeving-line through the hanks and lacing, and knot the ends together, after bringing up the bights of the head and lacing one by one; put a stop round every other cloth, and it is ready either for stowing away or bending.

384. SHIFTING A TOPSAIL.—"Watch shift main topsail;" "topsail clewlines and buntlines;" "away aloft;" "clew up and furl the sail." The sail-tackle in the mean time is cleared away, triced up, and hooked round the top-mast head, and its lower block hooked to a strop, which is seized round the bunt of the new sail.

When the old sail is furled, unbend the topsail sheets, clewlines, bowlines, reef-tackles, robands, and head earings; hitch the buntlines round the sail, secure the bunt robands to them, ease in, and lower the sail down on the weather side by the buntlines.

While you have been doing this, the new sail has been swayed up, carefully kept on the right slue, until the second reef-tackles can be bent; then give the order—"haul out," and lower the bunt of the sail level with the yard. Secure the bunt robands and head earings, and bring the sail to; bend sheets, clewlines, robands, reef-tackles, and buntlines; clear away the gaskets, "let fall," "sheet home," and "hoist the topsail." If blowing hard, the requisite number of reefs should be taken in the new sail before it goes aloft, so that the reef beckets may be rove and toggled before letting fall.

385. SHIFT MAINSAIL.—"Watch shift mainsail;" "away mft;" take in and furl the sail; unbend the reef-tackles and over-haul them down on deck; unbend buntlines, leech-lines, slab-lines, tacks and sheets—cast off head strings and robands, ease in, hitch the midship buntlines round the sail, and lower it by them.

The new sail is swayed up, *furled* by the stay whip, and the yard arms are hauled out with the reef-tackles; this done, bring to the head of the sail, bend tacks and sheets, buntlines, leech-lines, and slablines; cast off the gaskets, let fall, and set the sail.

386. SHIFTING JIB.—Haul down, untoggle the purchase, cast off the tack and jib pendants, and bend the reeving-line, (kept fitted), either with a seizing passed between the eyes, to allow it to pass through the sheave-holes, or with a small clasp hook fitted to the reeving-line. With a piece of sennit, kept seized on the stay under the sail, take a hitch round the stay, above the sail, to prevent it slipping down the stay in coming in, and to keep it in its place on going out. If blowing, a gasket must be passed round the sail. Bend a clew-rope from inboard to the clew, pull up the halyards, ease away the downhaul, and haul in on the clew-rope,—a hand at the boom-end lighting the stay through. When inboard, unreeve the stay, reeve it through the lacing of the new sail, and the downhaul through a couple of thimbles on the luff, take a hitch with the sennit, pull up the halyards, haul away the reeving-line and downhaul (the latter manned best,), easing the halyards and clew-rope; toggle the stay and pull up on the

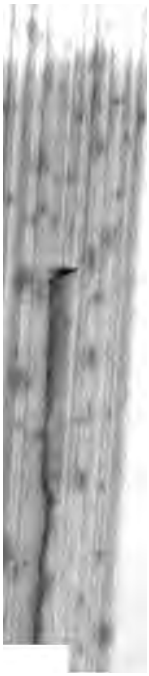
...gh the b
together. The ha
the tack secured t
the afterpart of th
the boom.

A jib-stay is som
shorter part, from in
through the sheeve-h
spliced into the end
part, a clasp-hook i
other part. Thus, it
stay through the boon
the foreacstle, the tw
hauled through the
hooked to the short p
fitted to set up abaft t
the boom end.

HOW TO TELL THE HEAD FROM THE TACK OF AIL IN THE DARK.—By the roping being on the le, which is the case in all fore-and-aft sails.

SHIFT JIB-BOOM.—Strike the fore top-gallant mast, he jib and flying-jib, unreeve the jib-stay, in flying m and leave it resting on the spritsail gaff and bow- irouds. Hook the topmast staysail halyards to a ound the end of the jib-boom, haul them taut and iem manned, haul taut the heel rope, ease up guys, pes and jumpers; slip the heel chain and crupper, e boom in by the heel rope, pulling up the staysail ls as the boom comes in; leave the funnel and resting on the spurs fitted to the bowsprit cap. A on the forestay with a shifting strop round the is used to take the weight off the end as it is run in. mean time the new boom has been shouldered and l forward, with its head resting on the knightheads. he heel rope and jigger with shifting strop, from the om, to the new; haul away the heel rope when d and rigged, hook the staysail halyards as before, eep easing them as the boom goes out. When out, pper and heel chain, fid the fore top-gallant mast, p back-ropes and jumpers, reeve and set up jib-stay, ing jib-boom. Set the jib and flying-jib.

SHIFTING A TOP-GALLANT MAST.—Furl the upper stop the yard-ropes out, unbend the gear, and send rds down. Land the royal yard in the top, unbend rd-rope, and unreeve it in the top, keeping the end cross-trees. As soon as the top-gallant yard comes



the yard-rope is wi
a hand on the cro
unreeves the rest b
away roundly, keep
soon as the royal s
the lizard, securing
lower away through
the heel aft, unsnat
the new mast has be
one, and *placed on th*
rope is unsnatched, i
deliberation, or fear
away, easing the hee
the lizard as soon as
trestle-trees, sway, pla
the royal yard-rope fr
reeving-line in the to
the mast goes up, re
ward aft, as soon as
The reeving-line, whic

ant masts fitted with snatches may be closed
a slide to slip in a groove on each side of the
:, by a strong iron pin, or with a couple of metal
ss the snatch, which, by a pin behind each, are
from opening except towards each other, when,
yard-rope, one must be close down before the
ɔe started. When there is not a lug, an eye-bolt
driven into the heel on the fore side of the mast,
e inside of the cross-trees, and prevent the mast
'ed through them, and also to bend a heel-rope
ich to steady the mast at sea in going up or
wn. Just above the square of the mast a hole
bored to receive an iron bolt with a shoulder to
:ye in it to attach a lanyard to; which preventer-
be kept at the mast-head, and entered directly
ɔpears above the trestle-trees, in order to catch
ı the event of the mast-rope carrying away when
ı hole may also be bored, with advantage, about
below the royal sheeve-hole, for the lizard to
ıgh, which allows it to be passed on sending the
ı, while the truck and rigging are being taken
e yard-rope unrove; and, in going up, to place
the same without "avast swaying."
edition, in bending and unbending the gear, fit
llant yards with chain quarter-strops, and the
ıcks with clasp-hooks. By having the chock in
rees, which confines the heel of the top-gallant
e to ship and unship, the mast can be sent down
–to leeward, without the necessity for lowering

390. SHIFTING A TOPSAIL YARD.—Take the s
unbend it, and haul it into the top. If, on the por
you are shifting the main topsail yard, stowed sta
side—port yard-arm aft, you must haul the mains
and send it up before the main yard; and the san
ward, on the starboard tack, fore topsail yard stowe
side—starboard yard-arm forward; unless you wi
keep the courses set, when you bring the yards o
windward. Pay down the sail-tackle whip, trice u
sail-tackle, round it up and hook it to the slings lash
on the quarter; unlash the quarter-blocks, cast
standing part of the clewlines, and the standing part
reef-tackles, unreeving the upper one, but allowi
lower one to go down with the yard-arm, making a
in the end; unsnatch top-gallant sheets, untoggle stu
sail tack blocks, and trice the booms up and dow
topmast rigging, easing them in off the yard by
earing. Hang the fly-blocks with jiggers to the to
rigging; unshackle the port tye-block forward, and
board one aft, and cast off the standing part of th
board tye at the fore topmast head, and port tye
main, round the tye down, and take a couple
hitches with the end round its own part close do
the tye-block, then haul taut and take a turn wi
halyards. Single the parral lashing, man the sail-t
attend the braces and sway away, easing the lowe
topping on the upper lift; then lower away, unriggi
upper yard-arm in the top, and the lower one on
Bend the top-bowline to the yard in order to send it
for the new yard, to guy it clear of the lower yard

n; if the yard is coming up to windward, the bowline ust be dipped under the lower yard. As soon as the wer yard-arm is unrigged, land the goose-neck in a shoe ed for it with a lanyard, and haul it along the gangway, here land it. Shift the sail-tackle and topsail-tye to the w yard, bend the bowline to the upper yard-arm (which better, I think, than putting the guying-block of the sail-ckle on—at least, when sending it up to leeward; but, hen to windward, the bowline perhaps may be dispensed ith, and the block used instead). To the lower yard-m hook a luff from the fore or main rigging, according the yard, to ease it forward or aft and keep it off the ck; sway up-and-down, and rig the yard-arms. Send hauling-line down from the top for the end of the reef-ckle, as soon as it is rove through the lower yard-arm, hich haul up and reeve through the block on the sail. an the sail-tackle and halyards, led on opposite sides of e deck, and sway away when ready, taking through slack f lower lift. When the slings are above the cap, take a rn with the halyards, walk back the sail-tackle and top n the lower lift, attending the braces. Pass out the nings and ends of the reef-tackles, haul out and bring e sail to. On quarter-blocks, send the booms out, bolt e tye-block, and secure the tye, sheet home, and hoist way.

The topsail tye is not always used.

391. SHIFTING MAIN TOPSAIL YARD IN A GALE.—Lower the yard by hand, unbend the sail and send it on deck. Lash the slings out to leeward, if you are trimmed

at all forward; hook the sail-tackle, get the booms off the yard, and the gear unrove. Put two burtons on the main yard-arms, overhaul the starboard one up (supposing the yard to be coming down the starboard side), and hook it to a strop half way out on the starboard topsail yard-arm, and the port one up under the main stays, and hooked to the same place. Overhaul a guy (fore tackle falls, or a small hawser), from a leading block in each gangway, and bend them to the starboard yard-arm outside the burtons, and the main top-bowline to the starboard quarter. Man the sail-tackle, port lift, burtons and guys. and sway away. Unrig the yard, let go the guys as they cease to become of use, land the yard, and use the same precautions in sending the new one up.

On such occasions, great difficulty is always found in steadying the yard to get the parral passed. To obviate this, before you sway across, hook a couple of jiggers from bolts in the cap to the slings of the yard, with which rouse the yard to.

392. A Sail Tackle—After use, requires over-hauling along the deck before stowing away, in order that it may reach the hatchway when triced up again.

393. Block of Sail-Tackle comes out.—Rack both parts together below the pendant, send a snatch-block up to the mast-head, snatch the fall, cut the racking, and sway away again.

394. Making up a Spanker.—Make it up on the head, doubling the leech in to bring it square with the head, then roll up.

5. MAKING A TOPMAST STUDDING-SAIL UP.—Lay ard on the deck with the fore side of the sail down- s, gather back from the head to form a skin, then ; the leeches and sail up to the yard a foot or two at a , bighting the downhaul along with the outer leech l to the whole length of the leech; pass the remainder ; the sail to the inner leech, and leave it out with the s; then roll up. When setting stops are used, one is d round the sail amidships, and another round the yard-arm, confining the halyards.

6. A LOWER STUDDING-SAIL—Is rolled up on the , and doubled in the length of the cover in which it wed.

7. STOWAGE OF SAILS.—When the sail-room will it of it, topsails and courses should be stowed with bight doubled back between the yard-arms, which, i roused out lies in the square of the hatchway ready hipping up, and all the time and labour usually lost eaking out, when the sail is stowed the whole length ie sail-room, is thus avoided. As the arrangements hips, below, vary so greatly, it is useless to particular- my special disposition of the sail to facilitate removal.

98. TOP-GALLANT MAST-ROPE.—The hauling part is through the lizard; for, if the standing part were d, the mast would be swayed up heel foremost.

99. THE STANDING PART—Is secured to that bolt in cap which will keep the mast rope in a line with the

sheeve. In the main, it will be the foremost bolt on the starboard side; and in the fore and mizen, the foremost bolt the port side.

400. TOP-GALLANT MAST GONE SHORT OFF.—Send a snatch-block up to the topmast-head, snatch the yard-rope, and pull up,—which will bring the mast in; then lash the yard, unbend the yard-rope, send the mast first down, and then the yard.

401. STOWING A JIB.—In harbour, when you stow the head sails in a cloth, if covers are not used, gather up from the foot, using the after cloths of the leech to form the skin, a little slack sail being gathered up to cover the hanks, &c., at the head, and stopped close down, and the clew hauled up and equalized along the boom. At sea, get hold of the leech of the sail, gather it on the boom, and pass the gasket.

402. MARKS AND DEEPS.—The marks are leather at 2, 3, and 10 fathoms, the two-fathom mark having a hole in it; white at 5 and 15; red at 7 and 17; blue at 13; and two knots at 20 fathoms. The intermediate fathoms are deeps.

403. DEEP-SEA-LINE.—Two knots at 20 fathoms, three at 30, and so on up to 100, when you commence again. Between every ten fathoms there is a single knot.

Mark it, by passing the line through a strand of the lead-line, and take a knot in it; then pass it through the next

hand and make another knot; and so on, as many as are required.

If a patent lead, or a buoy and nipper are used, there is no necessity for heaving to; but, if in deep water with a fresh breeze you want to get an up-and-down cast with a common lead, you will be obliged to do so; though, if the ship going very fast through the water, a luff up will in most cases answer the purpose.

When the lead is armed, carry it forward to the cat-head, pass the line forward from the weather quarter and bend it; place hands at intervals along the chains and quarter-deck, and let them coil up in their hands the quantity of line you require forward,—according to the depth of water. Let go, when ready; and as the line passes each man in succession, he calls out to the next,—"Watch there, watch!" should he not feel bottom. The quartermaster attends aft; marines hold the reel; and the line is watched and walked in. Sounding with the patent lead, care must be taken not to check the line.

WALKER'S HARPOON S
MACHINE.—The first whe
one revolution in 30 fath
the second one in 150.

Attach the sounding li
Machine by the hole A, ar
lead to the lower hole B, b
or endless rope about three

Before throwing out the
(which must be done with
rope), set the dials, by t
button D, on the first dia
pointer is opposite the n
and the index of the whe
other side of the Machine
150.

For additional satisfactic
more Machines may be u
same time, by having a l
about three feet long betw

. VERY DEEP SOUNDINGS—In a steamer are taken
nuch greater facility from the bow, as it enables you
id getting over the line.

. MARKING A LOG-LINE.—The length of the glass
28 seconds, the length between each knot must
he same proportion to 28 as 3600—the number of
ls in an hour, does to 6076—the number of feet in
ical mile. Therefore, as 3600 : 28 :: 6075 : 47·26;
feet 3 inches.

hort glass, of 14 seconds, is used when the ship is
upwards of five knots; in which case, to give the
ate, the number of knots that are run out must be
ed.

e knot, not the line, is divided into tenths; and, to
in calculating the distance that the last knot is over
ffrail, a single knot is placed midway between the
. This of course is equal to five-tenths, but, when
ot brought exactly on the taffrail the difference is
ed at. *Stray-line* is allowed before the knots com-
e, to let the log-ship get clear of the eddy in the
wake, previous to turning the glass, and is propor-
e to the height of the ship.

g-lines should be wetted before marking, or correct-
e marks, to allow them to take up, as they are always
hen in use.

276 WALKER'S PATENT HARPOON SHIP-LOG—The part marked A and B in the above figure does not revolve as it passes through the water, but contains the wheel-work for registering the number of revolutions of the Rotator C, which is caused to revolve as it passes through the water, by the oblique position of the vanes D D. The angle of the vanes is so adjusted to the wheel-work of the Register, that when the machine has passed through one mile, the finger of the first dial will have made one revolution; the finger of the dial No. 2 will have made one-tenth of a revolution, and index No. 3 will have made one-hundredth of a revolution, or in other words, the first index goes round one mile, the second index in ten miles, and the third in 100 miles.

It will be seen that in this Log the Rotator and Register are combined, the Rotator being

ontinuation of the Register or part that holds the wheel-rk. By this arrangement, not only is the machine made re compact, but the Rotator is protected from all front-d pressure, thus removing the principal cause of friction, d thereby enabling the Log to register *with equal uracy at all speeds.*

It will be observed that the float-plate F causes the achine to travel horizontally at all speeds; the side ssure, and consequent friction on the Rotator Spindle, ing thereby reduced to a minimum, and the durability f this, the only wearing part of the Log, greatly increased.

Directions for Use.—When the Log is to be used, con-ect it to the tow-line at M (the tow-line should be about o fathoms long), then place the first finger to 1, the econd to 10, and the third to 100.

Before throwing the Log overboard, *be sure to cover the ials and the oil-hole* by turning the sliding-case E E, in rder to prevent any dirt from getting into the Machine.

406. A SQUALL CLOSE UPON YOU.—Haul the mainsail p; lower the topsails, haul the reef-tackles out, and the buntlines taut; and, if likely to head you, keep the ship way a little to be prepared. If the jib and spanker are et, take them in, and set fore topmast staysail.

Under ordinary circumstances in squally weather, the invariable cry is, "Hands by the top-gallant (or royal) alyards!" Accustomed to the order from long habit, it repeated without reflection, from a vague notion of

safety in the measure, and to be in accordance with rule in the event of anything going. As midshipman of a boat, you would not keep the sheet belayed, in breezy weather, and station a hand, in preference, to the halyards. Neither should you do so as officer of the watch, for you know that the heavier the squall is the firmer the yard will bind, and consequently, that letting go the halyards before the sheet is eased off will relieve nothing. For the future then (if you have hitherto been misled, by custom, to the contrary), place hands by the lee sheets, and let the alarm of "Hands by the royal halyards!" henceforth die out with you.

407. TAKEN UNPREPARED.—Put the helm up, and ease over the boom.

408. SETTING FORE TOPMAST STUDDING-SAIL IN A BREEZE.—See the yards properly secured, the lifts and trusses of the fore yard well taut, the topsail yard well in, a jigger on the topsail lift, and the burton well up; if necessary get a preventer brace on. As soon as the boom is out, and the heel-lashing well secured, martingale it down with a knot in the lower halyards; steady taut the boom-brace, keep away and trice to hand. When above the fore yard, get the tack out and hoist away. The best knot for the lower halyards is a short sheepshank.

409. TAKING IT IN.—Keep away, ease off the short sheet, lower the halyards and walk away with the down-haul. Do not start the tack till the yard is close down to the boom-end; nor rig in, till the sail is well below the

ard. The deck sheet should be led through a block
ck, and well manned.

2. A SHIP IN TOW OF ANOTHER.—When the ship
l puts her helm down, to go round, the ship in tow
her helm up, and always endeavours to keep directly
r leader's wake.

1. IN TOW OF A STEAMER.—The steamer appointed
w you, having hoisted your pendants at the fore,
till you hoist your own pendants in reply, to indicate
you are ready, and then takes up a position ahead.
then send your hauling-lines on board, by which she
the towing hawsers in; and it is directed that the
board towing-cable, in all cases, is to be the best,
brought to the capstan of the ship towed for the
se of equalising the strain upon the towing-cables, as
s to assist in steering the steamer." A longer scope
reeze than in a calm, is of course necessary; mats
d be placed in the hawse-holes, the palls of the cap-
all down, and bars swifted.
a tideway, or in a breeze, the steamer first anchors
l, and takes in and secures hawsers; then the ship
s, lastly, the steamer.
ould the breeze freshen and the sea get up, direct
teamer to veer a breaker astern, which hook and take
hat, in the event of a hawser parting, there may be no
y in hauling on board another.
hen towing alongside, fore-and-aft springs should be
ed in addition to the bow and quarter lashings; one

hawser going from the after part of the ship to t
part of the steamer, and the other reversedly.

412. Rounding the Horn in the Winter M
—Bend a new suit of sails; reeve new braces and
and sheets if necessary; send topmast studding-sail
on deck; caulk the ports in; fit the second reef
courses; reeve the topsail bunt-lines double, thro
thimble seized into the foot, the standing part taken
the sail to the yard; fit leechlines to the topsails;
the boom-boats well; top the quarter boats up, and
them; get stern boat inboard; unbend cables, fit sta
preventer braces and trice them up to the quarters
yards when not in use; seize strops to the parrals o
sail yards, to hook the rolling-tackles to, and, whe
finished, you will be tolerably snug.

413. Clubhauling.—When a ship, working off
shore, has not room to wear, and is unable to tack, in
sequence of the heavy sea, her only resource, in the
of not anchoring, is in clubhauling.

A hawser is passed out of the lee quarter port
secured to the ring of the lee anchor, the helm put c
and the anchor let go and veered on; the cable is
unshackled ready for slipping, and slipped when the
cants the right way. When all safe, cut the hawser,
it go, buoyed, if you intend at any time to return to re
the anchor.

414. Grounded.—Clear away kedge, or stream an
according to circumstances, and get ready for laying i

ce, whether you are likely to do without it or not. e all aback, watch the lead, to see if she goes astern; if on a sandy or muddy bottom, let every man take a in his hands, and sally together from side to side: hich means she may work herself loose. If of no shove off with the anchor; if necessary, start your ; but should the wind be on shore, heave a good on the hawser or cable before doing so. If aground rd, and there is deep water astern, run the guns aft, *rice versâ*.

5. WITH A RAPIDLY FALLING TIDE.—If unable to the ship, you must prepare to shore her up, to pre- her falling over on her broadside; and therefore, sup- g that on the port side the water is shoalest, give her over to port by running the starboard guns in, passing hot over, &c. By means of the fore and main yards tays, get the spare fore and main topmasts over the side, with their heels weighted with shot to sink them; fore-and-aft guys to the heels to place them, and let heads take underneath the fore and main chains. on as she begins to settle down the right way, run ort guns in, close the ports, secure everything in its , and send top-gallant masts on deck. In the mean lay the stream and kedge out on the starboard side, st of the fore and mainmasts, lead the hawsers in , and heave well taut, for the purpose of steadying hip and relieving the shores.

careful not to list her over more than is sufficient revent her falling over to starboard, for the shores are

it the Survey was over, under the circumstances
the following description of the means adop
ter is extracted from Sir Edward Belcher's "V
Surveying."

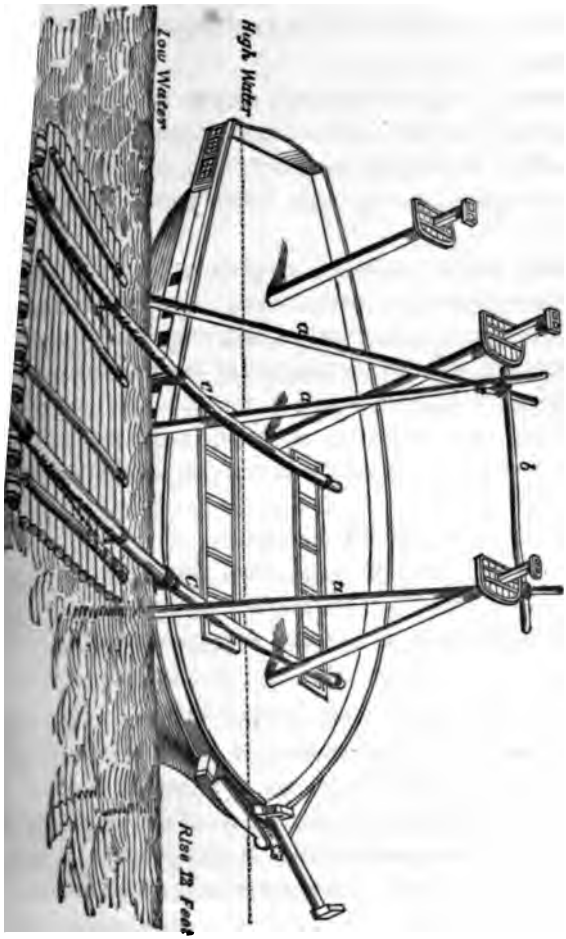
The new and extra stores were landed as soon
the ship hauled of her up-hamper, and bel
spring and the following preparations were ma

Three upright spars, *a*, *a*, *a*, were placed
with the fire chains between them and t
and to the fire side of the main chains—on t
side. The heads of the two latter were c
between them and the foremost one, a spar, *b*
to keep them steady in their places.

To the heads of these heavy purchases w
with the lower blocks lashed to the bights of
ing rowsed passed through the main-deck po
the skid beams.

From the fore and main mast-heads, on th
stakes were taken to a cable ashore, which
to the trunks of trees.

SHIP FALLS OVER AND FILLS.



lashed close down at low water, purchases were attac
from the heads of the shores, to act in conjunction with
power of the raft.

These arrangements proved entirely successful. As
tide rose, on the day the attempt was made, the
gradually assumed an upright position, and, being hove
to her anchor, was shifted to a safer berth.—July, 184

417. CARRYING ON.—The resistance by which a mo
body is opposed, in passing through wind and water, v
as the square of its velocity; and since the power t
exerted depends on the product of the resistance and
velocity, the power varies as the cube of the velo
Hence, to ascertain the alteration in the rate of sai
which will be produced by increase or diminution of
say—

As the area of sail, then set,
Is to the area of canvas about to be set;
So is the cube of the speed, then shown,
To the cube of the speed to be produced.

And, in the present instance, the speed will be foun
be only accelerated ·8 of a knot an hour.

If, then, so large an amount of sail as sixteen hund
yards, equal in this case to the main topsail and fore
main top-gallant-sails, prodnce so small a result; how i
except in emergencies, will a smaller amount of ca
cracked upon a ship to the endangering of the spars, c
pensate for the trivial gain in speed obtained at suc
hazard.

As a general rule, therefore, the moment a spar com-tins, in with the sail; and thus, knowing the futility of ssing a ship, you will be relieved from those unpleasant ments of hesitation, when tempted to hold on against r half-formed convictions to the contrary, you stand, h anxious glance aloft at every lurch and bound, the ge of hapless indecision.

418. UP SCREW.—Lifting screws are fitted in a banjo e, and require to be slewed with the blades up and n before raising. Reeve the screw pendants and falls; pendants are rove by reeving lines, which are always t rove through the sheeves in the banjo, and cross-e, or sheer-head, as the case may be; the standing t of the pendants are secured on deck with a round n, half-hitched, and the ends seized down. Deaden the p's way if necessary; man the falls equally, walk away dily, when high enough, put in the chocks, walk back falls and unreeve the pendants.

To get the screw down, reverse this operation.

419. DIS-CONNECT THE SCREW.—This is done in the w passage generally, by removing the connecting bolts; u are going fast, the speed should be reduced before connecting.

ew screws will commence to revolve under a speed of r or five knots, it is therefore a good plan if on a wind keep away a little after dis-connecting, and so start the ew.

...ter head of the wind.

... Twin Screws.—Are right and ... which I think that ... is ... opposi... after the ... that ... disadvantages ... are that the ship can be ... in a s... ... position, but that you will have th... with one of the other should fail, o... over. The disadvantages are, that ... are more liable to be fouled, and ... impede the ship more than a s... with two screws when cruisin... ... to stop one screw ... both screws should when movi... ... of revolutions not only for y... ... benefit of your next astern.

... In from a long Cru... before getting in have the paint-work ... cleaned, especially under the bows an... sail booms sent on deck and lightly pla...

before going in, holystone decks, scrub windsails, boats' r, and sails. Sling clean hammocks the evening before, ey at all require it. Accomodation-ladder holystoned in order; top-gallant masts fresh stayed, and squaring ks of lifts, braces, and buntlines looked to. As you r the port, down hanging-mats, off sea and up harbour tets, or, if used on the head of the sail, they will require king afresh; single the tacks and sheets, off spans of ail buntlines, see cables and anchors clear, buoy-rope ly and buoy blacked, chains to rights, and nothing ging overboard. If coming to, under sail, on ap- aching the anchorage, turn the hands up, shorten sail, forgetting to have a boat's crew warned to shove off square yards directly you come to; upper-deck sentries ly for going on, and stage party and stage ready with nt, &c., for going round directly the sails are furled. arbour furl of the head sails, if they are not wanted; n, if the topsails are sufficient to come to under, "Fore r-garnets, top-gallant and royal clewlines, studding- downhauls;" "Shorten sail." Let go the weather bor when you reach your position, veer away and nd on till far enough, when clew up the topsails and let the other anchor, giving her a sheer over the right way, s not to cross the cables, and hold on till you heave to avoid fouling the anchor. Furl sails and moor ship.

n an open roadstead, moor with open hawse to the vailing wind, if there is a predominating one; other- e, with open hawse to seaward. If in a tide-way, lay anchors for the flood and ebb, up and down the river.

Let me here recommend the plan of squaring yards with flags, as it possesses so many advantages over the general method. It saves the lungs of the boatswain, allows him to go to any distance from the ship, is not liable to be misunderstood, is far more expeditious, and, in a close harbour, saves all the intolerable bawling that follows the close of any exercise with the fleet.

Three small flags are required, bent to short staves,—red, white, and blue. Red stands for main; white, fore; blue, mizen. Boatswain faces the ship, and holds the flag on the side the yard requires to be topped. For lower yards the flag is held horizontal; top sail yards, flagstaff perpendicular; top-gallant yards, he stands up in the boat, and holds the staff at an angle of 45°; royal yards, flagstaff at the same angle, but the arm lowered. Masts can be stayed in the same manner. The flag need not be kept up all the time the yard is being topped on; but it can be lowered directly the boatswain's mate, on the jib-boom end, hold his hand up to show that he understands it, and should be waved when the yard is square.

423. MANAGEMENT OF CHRONOMETERS.—We will suppose that you anchor at Hong Kong, November 30th, 1856, with the chronometers run down; that they are numbered 2103, 742, and 254, and that their hands point respectively to 8h. 17m. 10s., 3h. 57m. 43s., and 9h. 30m. 22s. You therefore wind up one, 2103, shortly before 4 p.m. (time of place), by which you will set it to approximate Greenwich time (Hong Kong being about 7h. 27m. east of Greenwich); but as it is considered injurious to

h the hands of chronometers, and with many you are ble to get at the face to move them, you wait till it is 3om. by 2103, and then wind up 254; and, when ly 4h. by these two, wind up the third, 742; thus, for ake of convenience in computing their differences, ging them all near to each other.

n the following morning land with one, 2103, and tain its error by A.M. sights, or equal altitudes (Inman, 153—260), taking several sets. Repeat this on the eeding day; and, if these agree with the former, and naccuracies are detected, an interval of a week at a may elapse between the subsequent observations for

repare a "CHRONOMETER JOURNAL" according to the wing form, in which you note down the comparisons n every morning when you wind up, and by which you how the watches are going with each other.

he error of 2103 from the 1st to the 21st is that found ctly from sights; and the error of the other chronome- in the adjoining columns, is obtained by applying the parison; thus—

DECEMBER 1st.

m. *s.*		*m.* *s.*	
.....4 30	Slow of G.M.T.	2103.....4 30	Slow of G.M.T.
p....0 21	Fast.	Comp. 21 0	Slow.
..... 4 9	Slow of G.M.T.	254..... 25 30	Slow of G.M.T.

he daily rate on the 8th, 14th, and 21st, is found by ding the difference between the error on those days,

Dec. 1856.	TIME BY 2103.	TIME BY 742.	2103. S 742.	Daily Difference.	TIME BY 2103.	TIME BY 254.	2103. S 254.	Daily Difference.	TIME BY 742.	TIME BY 254.	742. S 254.	Daily Difference.
	h. m. s.	*h. m. s.*	*sec.*	*sec.*	*h. m. s.*	*h. m. s.*	*m. s.*	*sec.*	*h. m. s.*	*h. m. s.*	*m. s.*	*sec.*
☽, 1 ...	12 16 0	12 16 21	21	—	12 16 20	11 55 20	21 0	—	12 17 0	11 55 38	21 22	—
♂, 2 ...	12 29 0	12 29 22	22	1	12 29 20	12 8 13	21 7	7	12 30 0	12 8 30	21 30	8
☿, 3 ...	12 4 0	12 4 23	23	1	12 4 20	11 43 5	21 15	8	12 5 0	11 43 22	21 38	8
♃, 4 ...	12 15 0	12 15 24	24	1	12 15 20	11 53 58	21 22	7	12 16 0	11 54 13	21 47	9
♀, 5 ...	—	—	—	—	—	—	—	—	—	—	—	—
♄, 6 ...	—	—	—	—	—	—	—	—	—	—	—	—

Dec. 1856.	2103. — Slow.	Daily Rate. — Losing.	742. — Slow.	Daily Rate. — Gaining	254. — Fast.	Daily Rate. — Losing.	Hour of Winding.	REMARKS.
	m. *s.*	*sec.*	*m.* *s.*	*sec.*	*m.* *s.*	*sec.*		
1	4 30	—	4 9	—	25 30	—	8. A.M.	By sight at Kowloon Pt., Hong Kong. Lat. 22° 17′ 6″ N., Long. 114° 10′ 12″ E.
2	4 32	2·0	4 6	3·0	25 25	5·0	,,	
8	4 47·5	2·5	3 46·6	3·2	24 52·4	4·7	,,	
14	5 5·1	2·7	3 24·8	3·4	24 28·9	4·7	,,	
21	5 24	2·7	2 59	3·5	23 56	4·7	,,	
22	5 26·7	,,	2 55·5	,,	23 51·3	,,	,,	Sailed from Hong Kong.
23	5 29·4	,,	2 52	,,	23 46·6	,,	,,	
24	5 32·1	,,	2 48·5	,,	23 41·9	,,	,,	Exercised firing at a target.

ould, therefore, use the mean of 2103 and 254, hat they differ but three-quarters of a mile, and ject 742, which differs 4¾ miles from 2103, and s from 254, unless you had very strong ulterior or relying upon it.

have only two chronometers, and you find, when them up weekly, that the longitudes differ, take , unless you have good reason to prefer one to .

paring more than three chronometers, select one ndard, and compare each of the others with it, f with each other.

SECTION III.

ON GENERAL SERVICE.

424. CUTTING AWAY MASTS.—You first pass a outside the lanyards of the rigging on the side you the masts to fall over. If the port side, cut away th on the starboard side, as high as you can, for the will be of service in securing your jury-masts; and you have weakened it sufficiently, cut away all bu of shrouds on each side—guided by circumstances get out of the way and cut away the remaining sta rigging, keeping fast the stays till the mast has fallen you free them immediately, and cut the port ; shrouds adrift, which you will be able to get at, b being kept up by the hawser.

If all three masts are to go, commence with the mast, and work forward; although, when at ancho generally not advisable to cut the mizen mast awa is of great service in keeping the ship steady, head tc

425. ANCHORING WITH GUNS.—You have still guns left, and, having hauled in each cable as it shackle them altogether, point the end out and haul outside, by a hawser passed forward. When aft, la end with a good cross-lashing to the muzzle of the most of the guns you intend to use, and also to the

ıd at the same time get on lashing the remainder same manner, allowing a drift of cable between qual to the depth of water, in order that the first ng down may not tear the others out of the ports: mmencing aft, heave them overboard without loss

ld you have the good fortune to weigh them again, n the cat as they come up to the bows, and get ı through the bow port, if it will admit of its being By having a good drift between each, you will ıve the weight of one at a time to heave up.

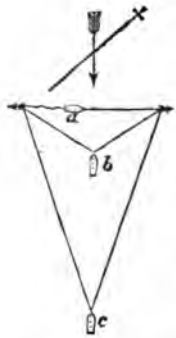
ld the guns not bring her up, you may be able to he spot to go on shore on, by getting up a short sheers, setting a staysail on them, and slipping the

eave a Gun overboard.—Cast loose, lay the gun hori- and ease her out, so that the muzzle may be just f the inside of the port. Hook two side-tackles to ısing bolts, and to a short strop under the neck, haul ell taut and keep them manned. Hook a train-tackle ı rear loop, and to the train-tackle bolt in the deck, nt and attend them. Unreeve the breeching, place an bar on the steps of the carriage on each side, ıe small ends under the gun, ready to elevate. ready, throw back the cap-squares, look out for the ıd at the order "Heave and haul," haul upon the ckles, heave on the capstan bars, and ease the e out by the train-tackles, the port being hauled up same time. In ironclad ships none but upper deck

guns could be thrown overboard through the ports, owing to the small size of the latter.

In the event of a ship getting ashore, and having to heave her guns overboard to lighten her, they should be slung by a single part of the breeching, for weighing; the clinch secured to the button, and then lashed out to the muzzle; using a breast-frapping for a buoy-rope and a truck for the buoy.

The reviser at first fully intended to erase the foregoing answer, but on second thought determined to retain it, as it may perhaps occur, that a ship should be obliged to use guns in place of anchors; though under the circumstances detailed he would feel more inclined to select the softest spot on the beach.



426. MOORING WITH OPEN HAWSE TO ANY BEARING.—Drop the anchors N.E. and S.W. of each other—at right angles to the prevailing wind; and, as the usual rule for veering cable is, to three times the depth of water, moor with about three shackles on each anchor, as at *a*, where she is shown lying with the wind from the N.E. When it shifts to the N.W. she will tauten both cables, and if not moored too taut, will drop down to *b*, in which position she will ride with safety in all ordinary weather. If the wind increases to a gale, you veer to *c*, with eight or nine shackles on each, previously dropping a third anchor if you think you will require it.

27. ANCHORING WITH A SPRING ON YOUR CABLE.—posing the wind to be directly on shore, and you wish, coming to, to bring your port broadside to bear upon you pass a hawser or stream-chain from the starboard rter, in through the starboard hawse-hole: run a range cable up before the bitts, and shackle or bend the am or hawser to it, which on the anchor being let go veered on, you work with a deck-tackle, and so you be able to spring your ship to a nicety, providing there o great shift of wind. Should this be an undesirable tingency, you must, of course, anchor by the stern, a kedge, stream, or sheet anchors, according to the ngth of the wind, and the importance of the case. If re is no immediate hurry, bend the spring after the hor is let go.

28. ON COMING TO WITH A WEATHER TIDE.—Look and give her a good sheer, to avoid being driven back r your anchor.

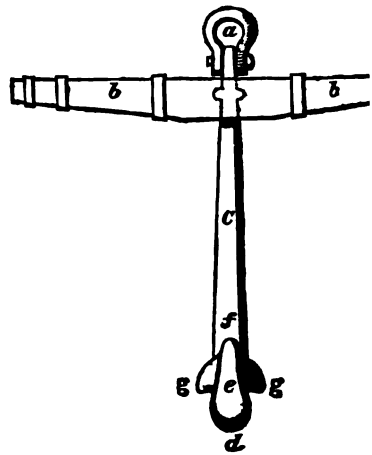
29. AT THE ORDER "STAND CLEAR OF THE CABLE,"—sides doing so, and standing by the compressor-tackle dy to bowse to, the chocks of the tumbler should be en out, but the pins kept in till the order—"Let go the chor," when they are taken out; but the lever is kept ck, by hand, till the boatswain gives the word—"One, o, three—let go," at the last sound of which the anchor freed by a rouse on the jigger.

30. PARTS OF AN ANCHOR.—In the Admiralty anchor, e shown, the stock is in two pieces, which are not

brought close together, in order that they may s against the hoops, and keep them taut.

In Rodger's anchor, the palm is smaller; and the which is solid, rests on a shoulder on the shank, keyed on the top by a bolt passing through the end shank.

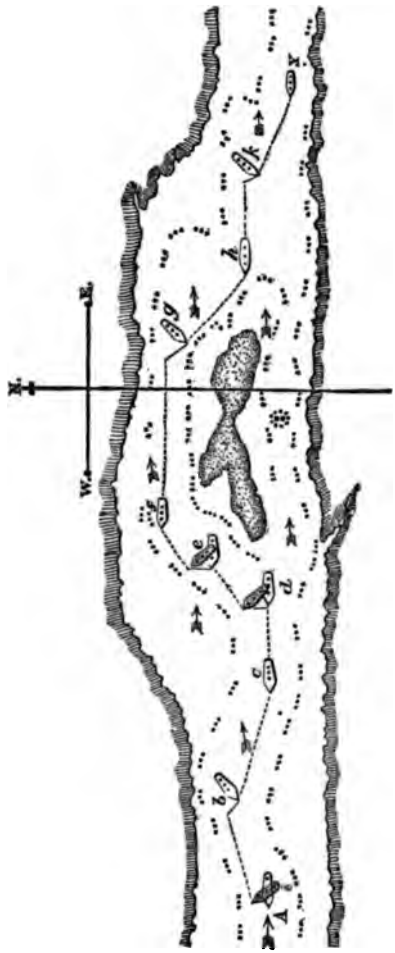
a. Shackle, or Ring.
b. Stock.
c. Shank.
d. Crown.
e. Arm.
f. Pea
g. Palm. } Fluke.



431. BACKING AND FILLING, AND DREDGING.—' with a foul wind, but with the tide in your favour, y in a river that is too narrow to admit of the ship b down, "backing and filling" must be resorted to. I at one or two points the river contracts so as to r this necessary, you may handle her by hauling the n sail up, taking the spanker in, and bracing the head y a-box, as you approach the narrows; squaring the she falls round off—bracing the after-yards aback,

filling if you wish to forge across the river, or
back, when
to near the
k.

rivers, how-
hat, for in-
which Shan-
tuated, you
lled to keep
annel from
rage to the
ure, and
hould weigh
small sail,
is sufficient
her under
Under or-
cumstances,
d main top-
ne handiest
ork under,
u would in-
if the wind
Under this,
fill, ease off
aft, as requi-



event of the
ing entirely,

the ship, necessarily would drift at the mercy of the cu
unless some other aid than that of sail were called
play, to enable you to keep her in the fairway and to
the shoals and dangers in the route; and through th
strumentality of the anchor it is that this is effect
what is termed "dredging." In narrow waters no ma
vre requires so nice an exercise of judgment, and
no circumstances are a quick eye and a clear head
requisite. While dropping down, the anchor is kept
ing by the slip, just clear of the bottom, and it is le
and a fathom or two veered according to the streng
the tide, when it becomes necessary to sheer over to
bank or the other. The capstan is kept manned; an
soon as the anchor is dropped, the cable is brough
again, ready for tripping the moment she is sheered
into the position required.

To illustrate this, let us suppose that a ship at A wi
to drop down to Y; that the three-fathom mark, represe
by the dotted line, is less than her draught of water;
there is a dangerous bank midway; and that the ar
denote the direction of the tide.

On heaving up and down at A, the helm is put a-
and she is sheered over in the position of the shaded fig
the anchor is tripped, and with her head the same wa
the helm being kept over while heaving up—she is drop
down to *b*. Here it becomes necessary to sheer her
to the south bank; the anchor therefore is let go, the h
put a-starboard, and she is sheered over to *c*, thence allo
to drop down to *d*. From this position, by succes

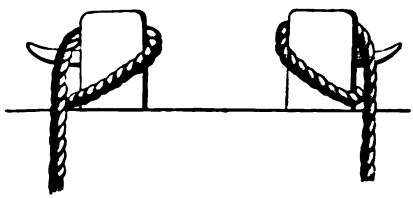
is sheered by the helm right across the stream, riving at *f*, proceeds as at first, till she reaches ıtion.

NUN BUOY.—Iron nun buoys are now supplied a ring and swivel at either end, to which the is bent, with a sheet bend, and the end seized. two other ways of slinging it. The first com- placing a strop or grummet round the buoy, on

of the centre; next, middling two pieces of ıg the bights on the top, and the ends down ınder the strop on their own end, and spliced strop on the opposite end; then, with two other rope, the same thing is done on the other end, roused taut up by a jigger hooked to the bights

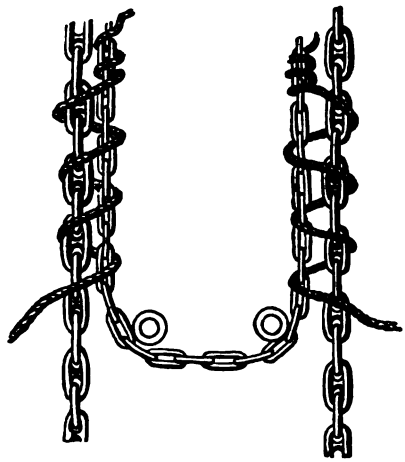
of the slings, and a thimble seized into each end tautens the whole. The legs and strops are serv the eyes hitched over.

In the second place, four pieces of rope are r and the bights of two laid over each end, form same number of legs as in the first; but no str used. Each leg of one end is spliced into the ne hand leg of the other end; scores are cut in the l their reception, and a seizing round the eye tauter up.



433. BI CABLES.—chain and cables are the same Facing forw in the cut, the starboard cable is bitted with the st the port against it; the cable from the hawse-holes l under the cross-piece or battledore, on the outside bitts, and the bight thrown over the bitt-head. A l tackle is used to rouse the bight up; the pendan through a swivel-gin over the bitts.

434. PASSING NIPPERS.—The *rationale* of pas nipper rests upon the necessity for bringing the mes to the cable, as you cannot bring the cable

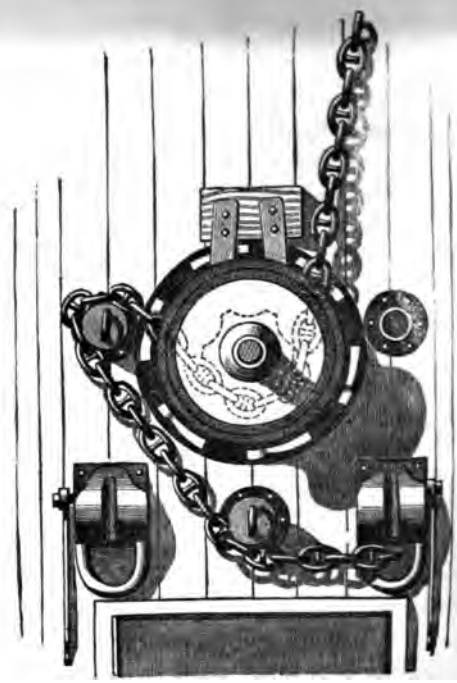


r, and at
ime rous-
nessenger
event its
nderneath
. Two or
ıs are first
ınd the
r by a
ide; the
en passed
cable to
s outside,
cing aft,
und, messenger and cable, as the latter comes in;
ort side with the sun, and on the starboard side
, rousing each turn taut as it is passed. The end
ogged round the cable, and twisted up with the
e next nipper; both ends are held on by a hand
ts aft with them, and, when far enough aft, the
started and passed forward again.

HEAVING THROUGH ALL.—Strew well with sand,
turns thick, and, if that is not sufficient, take here
a *round turn* round the messenger, and another
e cable, passing racking turns between.
obliged to use a deck-tackle to break out, heave
ıpstan and haul on the tackle *together*, giving the
ı *slow* pipe. It is amazing the difference that
es.

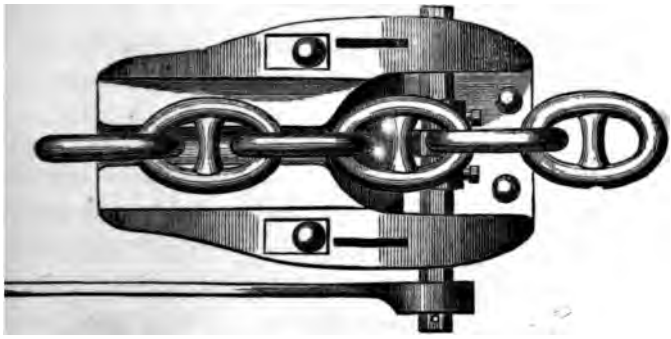
436. A DECK TACKLE—Consists of a runner and long tackle, separately fitted, the double block of the tackle hooks to the runner, the single block and the other end of the runner are secured abaft. The block of the runner is secured to the cable; the tackle may be used without the runner. Small vessels not fitted with capstans usually have the double block of the tackle fitted with a claw to hook over a link of a chain.

437. BRING TO, PATENT CAPSTAN.—Brown's patent capstans are now in general use, and the days of messenger



d nippers, are fast coming to an end. These capstans e fitted with sprocket wheels, corresponding to the links the cable, each link in turn binding in its correspond- g indentation.

To *bring to*, put the slip on, unbit, and haul the bight of e cable, round abaft the capstan, drop in the roller, and the chain into the sprocket wheel; the slack chain is



anled clear of the capstan with iron chain hooks. Ships itted with these capstans, also have a controller, into which the links of the cable successively sink as you heave in, and which of course relieves the capstan of much strain, the cable is thrown in or out of the controller by a lever at the side.

438. Number of Swivels in a Cable.—One in every other length.

439. A Length of Chain Cable—Is 12½ fathoms. They are marked inboard from the shackle, and sometimes on both sides, with a piece of wire or tin round the stay-pin of the link, a link for every shackle; the one next the shackle without a stay-pin not being reckoned. At the tenth shackle, when the cable is of that length, you commence again (though a cable, as supplied, is only of eight lengths).

440. Stay-pins.—Without them, the cable would become full of kinks; and, were they removed, the links would also collapse.

441. A Ganger—Consists of one or more lengths of chain, shackled to the sheet anchor and brought into the hawse holes, or just outside, and renders the operation of bending or unbending sheet cable much easier.

442. Advantage of Hemp Cables.—The one great advantage is, that they allow an anchor to be laid out farther from the ship by boats, being much lighter than chain, but in other ways they are more difficult to handle than chain cables.

443. Stowage of Hemp Cables.—Coiled with the sun; the starboard cable in the port tier, and the port cable in the starboard tier. When both ends are fitted with an Elliott's eye, the end is generally attached, by a

slip-shackle, to a chain strop round an orlop-deck beam. When not fitted with an eye, chain tails are shackled to the strop, and spliced into the cable.

444. STOPPERING HEMP CABLES.—In addition to the deck-stoppers used for chain cables, bitt, ring, and hatchway stoppers are required.

A bitt-stopper is a stout piece of rope, middled, with an eye which goes over the bitt-head above the cable, made by seizing both parts together. The ends are selvageed, brought aft and under the cross-piece, and dogged round the cable before the bitts.

A ring-stopper is a piece of rope middled, with the ends coach-whipped or selvageed. The bight is laid over the cable abaft the ring; the ends passed through the ring and dogged round the cable.

A hatchway-stopper is a piece of stout rope middled, and the ends coachwhipped. The bight is laid over the cable inside the hatchway, and the ends are passed through a hole in each side of the corner and dogged round the cable outside; so that, the greater the strain on the cable, the harder the stopper will jamb.

445. HEMP MESSENGER.—The ends are fitted with long lashing eyes, with the splice grafted over; but they are not brought close up to each other, as they would not lie fair round the capstan, the crown of the eyes, when brought together forming so great a rise: a drift of two or three feet is, therefore, allowed between them. Four turns are

taken round the capstan, the heaving-in part being the lowermost. When the opposite cable is to be brought to, the ends must be unlashed and passed the contrary way, which may be done, without heaving the turns off, by slacking them round the capstan, and dipping the aftermost end through; the parts then placed fair, and the ends relashed. Hands must be stationed to haul back on the upper part as it comes round the capstan.

446. After Unbitting—You lift the cable up on the cross-piece, or battledore, on which the messenger should be already placed for facility in passing the nippers.

447. Hemp Cables—Are stoppered below, round an orlop-deck beam, for bringing up at a short or long service, according to whichever it is intended to ride at; the bight, round which the lashings are passed being left outside so as to be easily got at. If intended to veer to the latter, the first must be previously taken off, and, when a longer scope is required, one abaft should be passed before the second is slacked off.

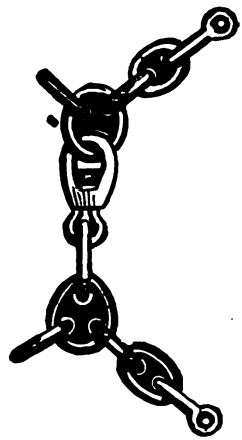
448. Preparing for Letting Go.—Run up a range of cable, before the bitts, sufficient for the depth of water; and, according to the weather, get a long range up abaft. Stand by to clear away in the tiers, lead the hook-ropes along, see stoppers attended, and a good kackling on where required in bringing up.

449. That End of a Cable—Is shacked to the anchor, which brings the bolt of the shackles and the cup of

swivels aft;—otherwise, they would catch the bitts, &c., unning out.

50. BEFORE SURGING—The cable should always be d; and also stoppered if the cat-fall is old.

51. PUTTING A SWIVEL ON.—; or heave in on the riding-, if necessary, in order to ; the shackle, where you in- to put the swivel on, before bitts. On slip before-all, un- kle and shackle the ends to pper and lower link. Stopper other cable inboard, or hang r the small slip attached to a h of stream chain, unshackle, each end in alongside the g-cable by a small hawser ed round the cut-water,—the t being kept up by a bull-rope from the bowsprit, and kle the ends to the remaining links of the swivel. Off pers of both cables (that of the riding-cable last), veer swivel out clear of the hawse-hole, haul in the *slack* of other cable, and make all fast. Ride, in this way, one cable inboard, for, when the swivel is hove up lships, the copper corrodes the cable, and the cable es the copper. In fine weather, as soon as the swivel ut on the riding-cable, it may, if you prefer it, be eased and the other cable shackled in a boat under the bows.



452. TAKING IT OFF.—
B.B.), stick out S.B—haul
a bull-rope from the bows
parts in through the star
terial which cable you clea
S.B., put the starboard slip
cable, unshackle from the
gether, off slip, and let run
before the swivel, unshackl
bowse to the compressor, a

If you think it undesirat
shackle it in a boat out-boar
by B.B., and with the swiv
side, pass the small slip a
chain, out of the spare haws
cable below the swivel; h
shackle the ends, and off

. MOORING WITH A SWIVEL ON.—You render it im-
le, by any amount of heaving, to do as you intend,
u have made no allowance for the depth of water.
: cables were laid taut along the ground in a direct
the fourth shackle of each, under the circumstances
d, could of course be joined—on the bottom; but,
1 attached to the bows of a ship, the difference
veen the base and the other two sides of the triangle
ie measure of the increase of cable required to unite
m. In this case, therefore, you would have to veer
ther shackle on one cable, mooring with five on one
d four on the other; or, else, weigh the second again,
d drop it closer to the first.

By running out seven shackles in the first instance,
fore dropping the second anchor, then veering four, and
aving in three, you would have been moderately taut
oored. The time of tide is also to be considered (at
rtsmouth, the rise and fall of spring tides; being twelve
et).

455. UNMOORING, WITH A SWIVEL ON.—If the cables
e up and down, there may be a cross in them below
ater; and, therefore, if you have nothing to guide you,
ou will likely enough shackle the ends of different cables
gether; but, by remembering which legs of the swivel
e cables were shackled to when you put the former on,
ou cannot misplace them. For instance, if the long legs
ere both on one side, and the B.B. shackled to them,
ou at once know which is the starboard cable. If either
the cables is taut, of course there is no difficulty.

456. Two Cables weaker than One.—In reference to this subject, Tinmouth has the following valuable remarks on the nature and properties of a span :—

"Supposing a ship to be moored between two anchors laid out east and west, with the wind blowing at right angles to that line, I have calculated that supposing a ship could be maintained in a position in which the angle EWN is 5°, the whole amount of support which the two cables would give to the ship is $\frac{17{\cdot}4}{100}$ parts, or about one-sixth the strength of one cable,

At the angle of 10° it would amount to $\frac{34{\cdot}7}{100}$ parts.

15° " " $\frac{51{\cdot}7}{100}$ "

20° " " $\frac{68{\cdot}4}{100}$ "

25° " " $\frac{84{\cdot}5}{100}$ "

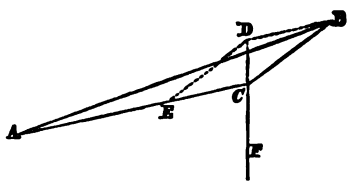
30° " " the strength of one cable.

"Many experiments have been made with pieces of rope, of various sizes, to determine this question, and in

it has been clearly proved, that when a span is as to have a less angle than thirty degrees, the the two parts of rope or chain, of which it is is less than the strength which one such part e if placed in a direct line with the strain.

er to prevent the numerous, and in some cases lents which occur in the use of a span, it is to investigate the peculiar character of a rope osition, that by the evidence of established l laws the reader may be enabled to understand nall force of a few pounds, applied to a rope or n in use at a flat obtuse angle, shall produce the ; strain of eighteen hundred per cent. upon it.

rope be extended from A to B with any degree ; if a force, small, be ap- ny part of the any direction e line AB, it a deflection, e tension on the rope.



e force F be applied at C in the direction d let the rope take the position A C B. Let h, C D, represent the force F; draw D B o A C, and D E parallel to C B; then C B ent the tension produced by F on the part C B , and C E that produced on the other part of C.

$$EC = F \times \frac{\text{sine DCB}}{\text{sine ACB}}; \text{ and } CB = F \times \frac{\text{sine DCA}}{\text{sine ACB}}$$

"Suppose F be taken = 10 lbs.; the angle ACB = 175°; and DCB = 50°; then the angle DCA will = 125°, and EC, or the tension on the part AC of the rope = 10 lbs. $\times \frac{\text{sine } 50^\circ}{\text{sine } 175^\circ} = 87{\cdot}8$ lbs. CB, or the tension on the part BC of the rope = 10 lbs. $\times \frac{\text{sine } 125^\circ}{\text{sine } 175^\circ} = 93{\cdot}9$ lbs.

"Hence, the greater the obtuse angle A C B, the greater the tension on the part A C, or C B, or on both parts, according to the direction of the force applied.

"If the force F, and the angle A C B, be supposed to be constant, the effect of varying the direction of the force may be seen.

"Thus, if D C F, the direction of the force, bisects the angle A C B, the tension of A C is equal to that of C B; and the tension on the whole rope A C B is a maximum.

"Again, if D C F be perpendicular to the part A C of the rope, the maximum tension is produced on the other part C B; and if D C F be perpendicular to C B, the maximum tension is produced on the part A C of the rope.

"It will be seen by this example that the small force of 10 lbs. applied to this span produces an effect of 87·8 lbs. upon one part of the rope, and 93·9 lbs. upon the other part; the whole effect being 181·7 lbs., that is, upwards of eighteen times the force applied. A still greater effect might be produced by a more obtuse angle."

157. KEEPING A CLEAR HAWSE IN A TIDEWAY.—We l suppose the river to run north and south, on which ring the anchors are laid out; and that you are riding he B.B. with the ebb and wind from the northward. the tide turning, you will, therefore, bring a cross in r hawse if you swing with her stern to the westward. avoid this, set the spanker and haul the boom over on port quarter; put the helm a-port when the flood ins to make, and take the spanker in when the wind is ght on the starboard quarter.

lefore the ebb makes again, you must be prepared to t her back to the eastward, now riding by the S.B., i the wind still from the northward; therefore, set the aker, ease the boom over on the port quarter, and at- l to the helm.

n the first case, riding to the ebb by the B.B., should wind shift to the eastward, you cannot avoid canting to westward, and, on being tide-rode, you will ride with a e in your hawse; but this will be taken out on the flood ing, should the wind remain the same.

he head sails will assist in canting, or at any rate, will ent her swinging back again when the spanker is of no ter use—the contrary sheets to that of the boom being led aft. But it must be borne in mind that the great ing power is the spanker, the boom being hauled right : on the weather quarter; and, if this will not cant her, must be moored too taut.

;8. CLEARING HAWSE.—Bring the small slip on a th of stream chain, out through the spare hawse-hole,

and put it on the dipping-cable (being the one she i
riding by), below the turns. If they are not above
you must heave in on the riding-cable, and bring the
and, if they still run below water, you must lash the
together as far down as possible, clear what are abo
lashing, heave up to it, and put the small slip on
can, but if not, lash again, and, lest the lashing shou
after you have unshackled the end, put a bolt throu
links of both cables and pass the lashing round it.
taut the small slip and belay it; put the slip-stopp
and unshackle the cable at the nearest shackle ab
slip, which, on mooring, should always be veered
the bitts, in anticipation of clearing hawse. Pass th
line (which is a small hawser rove through a block
bowsprit, and leading in on the forecastle) throu
hawse-hole, and bend it to the end of the cable;
bend a stouter hawser to the same end, knock off th
and haul out on the bowline. When outside the
hole, unbend the hawser and dip it round the ridin
the contrary way to the turns, the bight of the cable
ing by the bowline. Haul the cable taut in from the
slip, by the hawser, unbend the bowline, and th
comes out. If there are any more, bend the bowlin
repeat the operation. When finished, put on the sl
bend the hawsers, and shackle the cable, take
small slip and finally the slip-stopper.

459. KEEPING A CLEAR ANCHOR IN A TIDEWA
the by-gone days of hempen-cables, owing to the
done to them when lying on a hard bottom, a

[redacted]ity with which, on account of their buoyancy, they [redacted]d the anchor, tending it properly became a matter of [redacted]s importance; blunders were considered very dis-[redacted]table; and the management of the ship at turn of [redacted]required close attention and considerable experience. [redacted]now, thanks to chain cables, a ship with a long scope [redacted]cable out, may lie for months in a roadstead without [redacted]oaching her anchor, and in a tideway, as mooring is [redacted]the tedious operation of former times, and a foul [redacted]se can be cleared in one-tenth the time, ships seldom [redacted]ain for any lengthened period at single anchor. How-[redacted]r, when it is of importance to keep it clear, and an [redacted]hor-watch is kept for the express purpose of preventing [redacted]al anchor, there can be no reason why greater atten-[redacted]n should not be paid to it than is generally the case; [redacted]that is requisite being a knowledge of the effect of the [redacted]um on the rudder, and of the head and after sails on [redacted]ship.

[redacted]Supposing a ship to be riding by her S.B., with the ebb [redacted]e and wind from the northward, she requires, when the [redacted]e turns, to be sheered so that the bight of the cable [redacted]y not fall over her anchor, which would be the case [redacted]re she left to herself to drift up with the flood.

[redacted]Before slack water, therefore, put the helm a-port, for, [redacted]a ship in a strong tide ought to lie with a slight sheer [redacted]keep her steady, you will not require to describe so [redacted]at a circuit, by canting with her head to the eastward, [redacted]you would if you went round the other way. Hoist the [redacted]or staysail, according to the force of the wind, and

drive her over, or t
head sails become of
the helm is kept a-s
her with her head sl
cable brings her up ;
tide again turns.

When the tide turn
the jib and spanker a
to the eastward, takin
service, and you will li
helm a spoke or two a

Let the wind now
therefore, before the ti
and, as the tide slack
then hoist the jib with
ward, and, as the floo
dropping round to th
anchor, and head to t
her steady and the ca
made, haul the jib dow

a. LETTING GO SHEET ANCHOR.—The cable being led and clear inboard, out all stops of the ganger but r two outboard; clear away the berthing, see the r clear, jigger hooked to the slip, &c., and guns run t are likely to be caught by the cable. From forget- s of this, a ship some few years ago, letting go the r in a hurry, had a gun dismounted, the carriage led, and a beam sprung, by the cable falling across uzzle.

t. VEERING CABLE IN A GALE.—If B.B., brace the for casting to port, hoist fore topmast staysail with eet to windward, put the helm a-port, and veer away ort drifts at a time, having the lanyards of the deck- ers merely eased up, and kept manned ready for g taut. By thus canting her broadside up to the she will drift slowly, and take the cable easily.

2. WHY YOU VEER CABLE IN HEAVY WEATHER.—chapter *On the Properties of Chain Cables*, in Mr. outh's work, to which the reader is referred, is the answer to this question.

'The hemp cable," it is here remarked, "is well n to possess the valuable quality of elasticity sufficient commodate itself to any variety of strain when used able, but the chain is, on the contrary, so stubborn unyielding, that nothing but a long scope can render ; this is equivalent to additional strength, it permits

* Abridged.

the ship to rise over each succesive wave, under the constant pressure of a great strain, preventing entirely the danger of sudden jerks, which, of all other trials, is the greatest and the worst to a chain.

"It is a prevalent but fallacious notion, that, even when used in deep water and with a severe strain, the curvature or deflection of chain is considerable, and that near the anchor it rests upon the ground undisturbed by either the pitching motion of the ship, or the tension which she causes. At a testing strain of 630 lbs. per circular ½th inch, the utmost deflection was found to be only 10 feet upon a length of 100 fathoms, in 10 fathoms water, with the hawse-hole a fathom above the surface; the diameter of the chain being 1 ½ inches, and the strain 40½ tons.

"In a common gale, which would produce this strain, not one link of the 100 fathoms of chain will quietly rest upon the ground; on the contrary, it will be found by the experiments on a depth of 10 fathoms, that 127·98 fathoms of chain are required to form a semi-catenary* when suspended in air, and 137.03 fathoms when in water, the buoyancy of which must at all times have its influence. If the strain be less than that mentioned, the curvature will be greater, and no danger need be apprehended; but in a severe gale, the force of which may be supposed equal to, or nearly equal to, a breaking strain, it must be evident that a long scope is the only way to prevent a

* A *catenary* is the curve into which a flexible chain of uniform density and thickness forms itself when suspended, or allowed to hang freely from two points.

sult; and any man in charge of a ship at anchor, he necessary quantity of chain cable on board and astern to allow him to make use of it, but who cts to do so, must be considered the author of his misfortune, whether it may amount to the loss of his or or the loss of his ship."

163. MESSENGER CARRIES AWAY.—Bowse to the com-or, stopper the cable, and get up a span-shackle,—a g or a short one, according to the link carried away,

164. ANCHOR COMES UP WITH THE STOCK GONE.—Cat and rig a stage over the bows, and no difficulty will be nd, under favourable circumstances, in driving the ps on the new stock.

Otherwise it must be hoisted inboard.

165. FOUL ANCHOR.—If with the flukes uppermost, the end of a hawser up the fore-scuttle; get an chor-strop on the arm which is most convenient, hook cat to it, run it up to the cat-head; hang the anchor the hawser passed over the thumb-cleat, and with the hitched round the cat-head; haul taut, unhook the and shift it down to the ring; ease down the hawser, with the cat, and clear the cable, using ring-ropes en wanted, and, when clear, haul in the slack of the ble. Slue-ropes on the stock are often of great assist-ce in clearing the chain.

When an anchor comes up foul, with a turn round the ock, and you cannot clear it at the bows, or hook the

cat to the ring, you hook it to an anchor-strop round the anchor so as not to jamb the chain; and up, clear it by dipping or unshackling it.

466. THE CAT IS HOOKED—from out—in, bec is thus the more easily lowered and pointed thro ring of the anchor. The fish is hooked to the in from forward—aft. (Cat-chain, see answer 121.)

467. CAT-BLOCK GONE.—Replace it with the sp

468. LETTING GO FROM THE BOWS.—Before le you must put the slip on, take the nippers off, cable, and haul the compressor back.

469. SWEEPING FOR AN ANCHOR.—Divide one deep-sea lead-lines, according to the depth o between two cutters. Pull to windward of wh suppose the lost anchor to be (knowing your bearings); drop the bight, weighted with l intervals, and open out. Pull gently down to keeping the leads at the bottom until they ca anchor; then cross the boats and haul up to it.

If there is much cable attached, see if you can of it with a creeper near the end; and, if you take it in through the hawse-hole, shackle on, an the anchor. In case you should be too far off to from the berth in which you then are, get unde and warp up.

If unable to get hold of the chain, send ba with a 2-inch hawser, and, guided

which has got hold with the lead-line, drop the
of the hawser over the anchor; knot a piece of
und both parts of the former, as close as you can
having it so taut as to prevent its running down;
couple of shot to it, and, in order to jamb both
nd prevent the anchor slipping out of the bight
eaving up, let it slip down the hawser. A large
shackle may be used instead. Pass the ends of the
in, clap a deck-tackle on one part, take the other
he capstan, and heave the anchor up. Or, connect
er and main-deck capstans, and take one end round
stans, on each deck.

CAT-HEAD AND BOOMKIN CARRIED AWAY.—Brace
the fore yard, and secure it as for hoisting the
in. Lash a top-block on the yard to plumb the
nd through it reeve the top-tackle pendant, passed
e cap and hitched round the quarter of the fore
Reeve the top-tackle purchase on deck (splicing
ether if necessary), take the cat for the lower block,
h secure the standing part, and reeve the hauling
ner through a leading-block or the upper block, and
on deck through a block on the cap. Trice the
e up by the yard-tackle—lashed in, and hook it to
dant. Overhaul down, hook the anchor and hoist
sh and secure it in the usual manner, except that
is brought in to the side by the cat-head stopper
ound the timber-head.

slip it up the shank,
Put another strop roun
up, and secure the yar
bracing the main yard
up from the bowspri
Hook the fore yard-tac
fore purchase to the rir
strop on the crown.

Ease away the hawser,
by a burton from the for
have a stock-tackle led a
required, a tackle from
wanted, and a stay-tackl
from the main yard is ve
The sheet anchor is so
couple of fish-davits ; or t

472. TRANSPORTING W
The quickest way is to let

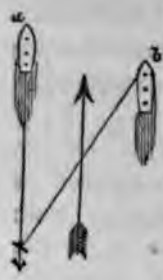
473. COMING TO WITH A

by the hawser and buoy-rope, with the fluke for-
reer cable on reaching the bottom, and, when you
t it holds, unreeve the hawser and stream the buoy.

WEIGHING UNDER SAIL IN A FRESH BREEZE, VESSEL CLOSE ASTERN.—Heave in as short as ermits; loose the courses, jib, and spanker, brace ls for casting, set the foresail, and hoist the jib with et to windward. Trip your anchor, attend the ıe watch below and idlers remain at the capstan, n deck make sail), board the main tack, and brace :he head yards when she pays off, haul out the , let draw the jib-sheet, cat the anchor, and loose ails.

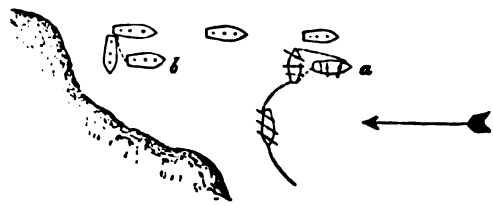
A SWELL ON THE PORT BOW, AND NOT ROOM TO STARBOARD.—Lay a kedge out, buoyed, on the d beam; pass the hawser out of the starboard port, reeve it through a strop and toggle on the he anchor, and bend it to the crown. Bend a to the toggle, and let the boat that lays the kedge l on to the buoy, and stand by to slip the toggle. in, spring on the hawser, weigh under the jibs, slip le, trip the kedge and run it up to the quarter, ur boat up, loose, and make sail.

WEIGHING IN A WEATHER TIDE, WITH THE UT AHEAD OF HER ANCHOR.—The ship will not dside to the tide, because the effect of the tide on ıdside may be greater in proportion than that of



the wind; and she may still under the same circumstances remain ahead of her anchor, because the wind acts with greater force on the ship's stern and on the squared yards, than the tide does upon the bow. Riding then by the S.B. at *a*, port the helm and sheer her over to *b*, where she will remain at a taut scope, stemming the tide; then heave in.

477. WEIGHING UNDER SAIL FROM A CLOSE BERTH.—Make sail, weigh, and cast to port with the head-yard a-box, and the after-yard square, towards the object yo wish to clear, with the helm a-port; for, as you necessaril



get sternway in casting, you recede from the danger t turning her head towards it, as is shown by the ship Starboard the helm as she gathers way, brace up the aft yards, and come to the wind on the port tack.

Were you to cast to starboard, or from the danger, y would back into it, stern foremost, as the ship *b* has do

478. THE ANCHOR SHOULD NOT BE TRIPPED.—U you see that the ship is canting the right way; and, if c

ing to the wrong way, you must hold on till she casts as you require.

479. WEIGHING UNDER SAIL IN HALF A GALE OF WIND, CLOSE TO A LEE SHORE.—Pass a stream-cable from the quarter port, forward, on the side of the tack which you intend to stand on, and shackle it to the bower cable, in or outboard as most convenient. Send hands aloft to be in readiness to make sail, taking in such reefs as are necessary; man the topsail sheets and halyards, having braced the yards about a point forward; veer gently on the cable during a lull, heaving round on the stream till the wind is nearly abeam; sheet home the topsails and hoist them; and, as the sails will be shaking, little strain will be brought on anything, nor much additional pressure on the ship. Be ready to slip the cables, man the lee braces, mizen sheet, and fore topmast staysail halyards; brace up, hoist away and haul aft; man the fore and main tacks, slip the cables, and haul aboard.

480. BACKING AN ANCHOR.—If in preparation for hurricane weather, heave in or veer away on the anchor down, say B.B., till you bring the fourth shackle some few fathoms abaft the bitts; put the slip on, unshackle and unbit; pass the end out and shackle it to the ring of S.B., which has been eased down to the hawse-hole; off slip, and ride by S.B. cable, with its anchor at the bows until the gale comes on, and then veer it down to the ground. Should the gale pass off, you can hang the B.B. cable outside by the clear-hawse pendant, and replace both in their original position.

If, on veering to 50 fathoms on S
found the gale still increasing, shackl
maining hundred fathoms of the B
(supposing that there are three cable
between the two bowers, as is usuall
—let go starboard sheet anchor,
away on both. Finally, if compelled
violence of the storm to make the
your resources, shackle the oth
cable to the end of the one already d
veer away on both to within a few f
the clinch, keeping that in to freshe
of the hemp cable with. You will t
to be hoped, ride it out with three
down, and 500 fathoms of cable ahea

With more than two cables ahe
is little probability of the strain bein
divided, unless they are systematicall
in fine weather; and, with four ancho
ships have snapped their cables
another, partly from the same ca
partly from the fatal effects of sudd
upon a short scope—such as a
fathoms would be in a gale of great
But an anchor is backed only when t
ing-ground is bad.

A length of 250 fathoms on one anchor is unnecessarily long, though in the above case it

ided by the position of the sheet anchor, which you e obliged to veer on, because (as generally happens in tice), it was not dropped until, having veered on the ng-cables, you were compelled, on account of the easing wind, to let it go. But, to ride a storm out, should certainly not have less than 150 fathoms of in on each anchor, in 10 or 11 fathoms' water; and, if chain is expended in backing, you can afford this on a of the bower anchors when dropped near each other: r then, three shackles on each, and hold on at this as g as you can. When the gale has set in, let go the st, and veer away on all three anchors; shackle the sheet cables together, and you will then lie with three hors ahead, with a cable and a half on each, which is bably the best disposition that can be made.

81. To make a small Kedge more effective.—h a pig of ballast, or other convenient weight to it.

82. Laying a Bower Anchor out by a Launch ng Trunks.—There are many different plans of carry-out an anchor, and each has some special advantage recommend it, but should your launch be fitted with iks, and the water where the anchor has to be placed, very shallow, I believe there is no plan better than the owing:—Reeve the cat and fish falls, and put the stock tle on, haul taut these, slip the shank painter, cockbill anchor, off ring stopper, and stock tackle. Ship the ship trunks, windlass, and anchor davit in the launch; l haul her before or abaft the anchor as the case may

be, taking care that her head is to the sea, and her stern near the anchor.

When you have placed the boat, put the bight of a stopper over the nearest fluke, half knot it—or better still—cross and seize the parts close to the fluke, bring the ends up through the trunks, and with the windlass heave the anchor close up to the boat, lowering the cat at the same time. Then take another stopper through the ring of the anchor,—one end is taken over the roller in the stern davit, and led through the ring-bolt of the after slings with a round turn, and secured to a thwart; the other may be led over the stern, and set up with a luff hooked to the ringbolt of the foremost slings, rouse the ring of the anchor close up to the launches keel, after having unhooked the cat.

Send as much cable with the anchor as the boat can safely carry, and make fast another boat astern of her with the remainder.

Meanwhile, the cable has been stoppered at frequent intervals; and a cutter has been dispatched with a kedge and hawser for them to warp out by. This kedge should be placed well ahead of the position in which the anchor is to be dropped, otherwise it will come home before the launch gets there: the cutter should then return on board with the hawser. Pass the warp into each, let all hands clap on, haul away, and pay out the cable to the bottom as you go. If each fake is stoppered to a thwart or ring-bolt in the boat as it is coiled away, there will be no danger of its taking charge when you pay out.

s soon as you have warped up to your position and all cable is payed out, ease down the luff until the anchor ear of the boat, have a sharp axe ready in case of any- g holding, stream the buoy, and slip the stoppers to- er at the order "let go."

s chain cables are nearly twice-and-a-half the weight corresponding hemp ones (being in the proportion of 4 to 6.7), the latter should be used in preference when s necessary to lay out upwards of 70 or 80 fathoms, or bad weather, when any considerable load would endan- the boats.

f you hold on the cable till the anchor is let go, and n pay out as you return on board, you must first ease un sufficient to reach the bottom, or the anchor on ing let go, will take the boat with it. For this purpose, ight of chain is usually stopped round outside the boat, dy for dropping; and, if this is not enough, more must payed out.

If you have to warp out against the wind and sea, lay e cable down on your return; if before it, pay out as u go.

WITHOUT USING TRUNKS.—Rig the fish-davit; sling e flukes with a span formed of two stout pendants; ch one round each arm of the anchor as it lies on the ll-board, close up to the palms and splice a long-eye to the other ends (all of which can be done while the vit is being rigged); nail a couple of cleats, to form a k, on each end of a small spar or oak plank, about ghteen inches longer than the beam of the boat amid-

ships; place this in the span, allowing sufficient drift
the boat to pass between it and the anchor; toggle
eyes of the span together with a large toggle, fitted wi
stout lanyard, and seize each end of the stretcher to
span, to prevent it slipping down when the ancho
lifted. Hook the fish to the span, and the cat to the
of the anchor. Pass a strop round the shank, and la
up to the upper stock, leaving the bight above the lash
just long enough to come in over the boats stern.
the gunwales down, midway between the two after-thw
to receive the stretcher (which scores may afterwards
fitted with shutters, to be ready for future use on a sim
occasion). When a span is not used, the lashings
slinging the anchor should cross inside the boat, to
the sides together.

Haul taut cat and fish, slack up ring-stopper and sh
painter, and ease the anchor down. The moment it is l
enough, the launch hauls up, stern foremost, passi
through the span, and bringing up with her stern again
the stock. The slip-rope is rove through the ring-bolts i
the stern and keel, lashed down and well parcelled in th
wake of the latter one; the ends are knotted, and th
bight is toggled to the bight of the strop on the stock
The stretcher is then lashed down to the boat, and the ca
and fish are unhooked. Connect both toggles by the sm
lanyard; form an eye in the bight, by crossing and seizing
both parts together, so that a jigger from the bows of the
boat, hooked to it and hauled on, will bring an equal strain
on each part. To let go, proceed as already described,
only man the jigger in place of slipping the stoppers.

With a heavy wash under the bows, so that the launch ld not lie under the cat-head with her stern forward, anchor must be cock-billed, the cat hooked to the span, the fish to the ring, the cat-head-stopper eased up, the hor squared with the flukes forward, and the launch ed aft by a boat-rope from the jib-boom end, steadied, cessary, by a whip from the fore yard-arm, braced rd.

hould you find, on easing down, that the boat will not the anchor safely, take the weight off it again, and as many water-casks under the bilge as you think will fficient (the buoyancy of a butt being eight cwt., and of a puncheon upwards of five).

It must be borne in mind that the weight of an anchor the water is less than what it is out of the water, by the ght of water that it displaces. The specific gravity of ught iron is 7·788, and of salt water 1·026; therefore, specific gravity of iron in relation to water—7·788 ÷ 26, is 7·59. The largest wooden stocked bower anchor ghs 95 cwt. with the stock; but, as the oak and hoops , as nearly as possible, of the same density as water, the ck—five cwt., need not be taken into consideration. nsequently, the weight of the anchor, minus the stock, vided by 7·59, gives the decrease of weight when the chor is submerged; in this case equal to 11·86 cwt.

Or, the decrease of weight consequent on the immersion a body may be found by calculating its cubic contents, nd then ascertaining the weight of its equivalent bulk of ater.

90 cwt. = 161280 oz., which, divided by 778
specific gravity of iron reduced to the same standard),
a quotient of 20.7, being the cubic contents of the a
in feet. Now a cubic foot of salt water weighs 64·
and, therefore, 20·7 cubic feet weigh 1329 lbs., or 11·8
as before.

483. LAYING SHEET ANCHOR OUT BETWEEN TWO B
IN HEAVY WEATHER, BACKED WITH THE STREAM.—
out the two pinnaces: send one away to run out a k
and in the mean time, get the stream anchor and p
the stream chain cable into the other. To the stream
lash a block, large enough to take a 7-inch hawser,
distance from the anchor equal to about twice the
of water in which the anchor will be let go. Reeve
middle the hawser, and pass both ends inboard.
the boat out by the kedge, and let go the stream an
well in advance of where the sheet is to be drop
Leave a cutter to buoy up the cable when the blo
lashed, and come on board.

While this is being done, the yard-tackles are got d
the anchor slung and lowered down square, stock ath
ships. Two spars being prepared, the pinnaces' gun
are cut down amidships where the foremost spar lies, an
aftermost spar is lashed across the sterns. The boats l
hauled up on either side of the anchor, it is slung w
long strop round the upper fluke, passed over the fore
spar, and toggled to a strop, round the shank abaft, w
is passed over the after spar; and the stock, lying a
the sterns, is lashed to each boat to keep it steady.

ch is then made fast to the boats, and they are hauled
on board the ship to where the cutter is buoying up
stream cable. This they take in, and send the cutter
k with the end of the 7-inch. When they get hold of
hawser on board, it is bent to the end of the sheet
le (the ganger being unshackled); then the hawser is
med, and the cable hauled out to the boats and shack-
to the anchor. The stream cable is then hitched round
shank, and seized, and allowed to slip down to the
wn; the stock lashings are cast off, and the anchor is
go, with the ring towards the ship, by a jigger on the
yard of the toggle.

484. To find the number of Casks requisite to
RRY OUT A 95-CWT. ANCHOR.—A butt holds 110 gallons,
l a gallon of (distilled) water weighs 10 lbs.; therefore,
0 × 10 = the floating power, 10 cwt. nearly.
The weight of the casks themselves need not be con-
ered, as when they are submerged it is inappreciable.
e anchor, as has been shown, loses nearly 12 cwt. by
mersion; and, as the weight of the stock—5 cwt., is not
, eight butts should be *sufficient* to support it, though
ubtless ten would be safer.
A spar (spare jib-boom) would be required to secure the
ks to. They should be whipped over ready slung, and
ced at each end, and in pairs on each side of the spar,
ving the centre clear for the anchor. Hang it by the
g, with a small lashing round the spar and ends of the
ck, to keep the latter fore-and-aft. Cast these off
fore letting go. If the water be very shoal, or circum-

stances otherwise unpropitious, it may be necessary to sling the anchor flukes forward; in which case it will be hung by two lashings, instead of one—a disadvantage when the operation of letting go is performed with an axe.

485. To calculate the Capacity of a Cask.—Multiply half the sum of the areas of the two interior circles, viz., at the head and bung, by the interior length, for the contents in cubic inches; which, divided by 277·27, the number of cubic inches in a gallon, reduces the result to that measure.

Supposing that the casks at your disposal measured 21 inches in diameter at the bung, 16 inches at the head, and 28 inches in length; then 346·4 and 201·1 would be the respective areas, and their half sum—547·5 multiplied by 28, and divided by 277·27, would give 27·65 gallons for the contents, which is the capacity of a beef-barrel.

486. To ascertain the number of 4-ft. Tanks requisite to carry out the same Anchor.—The cubic contents of the tank being 64 ft., and a cubic foot of (distilled) water weighing 1000 oz., or 62½ lbs.; 64 × 62·5 = floating power, minus the weight of the tank (which in water would be about 6 cwt.), or 30 cwt. nearly. Three tanks, therefore, would be the number required.

487. To calculate the Floating Power of Spars, for the same purpose.—Try the three spare topmasts; the main being 64 ft. long (exclusive of mast-head); diam. 22 in.; fore, 57 ft., diam. 22 in.; mizen, 45½ ft., diam.

[redacted]. The weight that they will sustain, is the difference [redacted]een their own weight and that of the water they [redacted]lace.

[redacted]o ascertain the weight of a spar: multiply the square [redacted]e diameter by ·7854 (the area of a circle whose diam- [redacted]is one inch), to find the area; multiply the area by [redacted]length, to obtain the cubic contents; and the product [redacted]he weight of a cubic foot of the material, ascertained [redacted]xperiment.

[redacted]ain topmast.—The greatest diameter being 22 inches, [redacted]proportion of diameter at 1st quarter is $\frac{60}{61}$; 2nd quar- [redacted]$\frac{20}{21}$; third quarter, $\frac{8}{9}$; equal to 22 in., 21·6 in, 20.9 in. [redacted]19·5 in., respectively; consequently 21 in. is the [redacted]n diameter.

[redacted]4 ft. = 768 in., and $21^2 \times ·7854 \times 768 \div 1728$ (the [redacted]nber of cubic inches in a foot) = 154 cubic feet.

[redacted]ore topmast—57 ft., in like manner gives 137 cubic [redacted]t; and

[redacted]izen topmast—45·5 ft., with a mean diameter of 16·2 [redacted], is equal to 65 cubic feet.

[redacted]otal, 356 cubic feet.

356 × 64·1 (the weight in lbs. of 1 cubic foot of salt water)... ...	=	22819 lbs.
356 × 36·3 (the weight in lbs. of 1 cubic foot of Norway spars) ...	=	12923 „
Floating power of spars ...	=	9896 = 88 cwt.

488. Out Stream anchor and Cable.—Dro launch alongside; put the gear into the lumber unship the rudder, as you will steer with an oar, a luffs, strops, and davit in the boat ready for weighin lead and line for sounding. Lay the ends of two c bars over the stern, spread out, and rest the othe lashed together, on the bights of the cable when it is away, over the after-thwart, ready to receive the Clear away the anchor in the chains, stop the yar in with a strop round the pendant, bend on a fore-a from the gangway, lift the anchor out with yard a stock it with a whip and burton from the main yar the buoy-rope double through a block on the cr weighing, and lower it down with the stock athwa resting on the capstan bars, and the flukes up an the stern. In the mean time the end of the cal been passed up, taken from the hatchway round t bitts, and so walked round, instead of being roused standing pulls from the hatchway to the port. C cable away on the top of the thwarts, stopping the l outside the boat under the rowlocks, in preparat letting go, as cable equal to the depth of water m payed overboard before the anchor is dropped, to the gunwale being torn away. Send boats ahead the launch in tow, and shove off. When required go, cut the stops of the cable outside, stream the and ease the anchor over on the capstan bars by the crossed ends.

To weigh the stream anchor in a launch, ship th

the stern of the boat; lift the cable over its end and clap the double block of a luff on the cable, and the single block is hooked to the bows of the boat; it is best to use two luffs fleeting them alternately, and if the anchor is hard to break out, put one luff on the fall of the other.

489. In expectation of being fouled by another ship.—Send hands aloft to drop the foresail, put the slip on, unshackle the cable, bend on a hawser, and, as your friend approaches, off slip and give him a wide berth. In a fresh breeze, stand by to veer instead of unshackling.

If collision be unavoidable, get the swinging boom alongside, lower the quarter-boats and ports, overhaul lifts and trusses, and brace the yards up on the tack opposite to the side the ship is on.

490. Anchoring in a Boat on Rocky Ground.—Bend the cable to the crown of the anchor, and stop it to the ring before letting go. Should the anchor catch when you weigh again, a heavy strain will come on the stop, which will carry away, and enable you to break out flukes uppermost.

491. Away with a Seining Party.—A ship's seine is about 360 feet long by 12 deep, with a purse in the centre, about 16 feet deep, to confine the haul. To each end of the seine a staff is seized, weighted just sufficient to sink it; the lower part is square with the foot of the seine; and to one end of each pole a line, from 80 to 100 fathoms long (top-gallant studding-sail tacks and halyards), is bent, and spanned out to the other end. This being done, the

seine is payed down, and coiled away in the stern sheets of the boat; and a dingy accompanies the latter to underrun the seine, should it catch against rocks on the bottom. On reaching the beach, a few hands remain in the boat, and the remainder stand by to man the hauling-lines. The end of one line is hove on shore, and held on to; the boat pulls out to the extent of it, and then shoots the seine in a direction parallel to the shore, or round the space you intend to sweep, taking care that the bunt goes out clear, with the mouth open to the shore; when all out, the boat pulls in with the other hauling-line; then both are manned and walked away with, closing as you go. When you get hold of the poles, the lower ends are canted in, and the foot of the seine held down as it comes up.

Succeeding hauls are made in the same manner, and the ground is shifted as the fish become thinned; pipes and fires are lit, and a broil accomplished on the embers, &c.

492. To ascertain the Quantity of Water a Boat will bring off.—A butt holds 110 gallons, and a puncheon 72 gallons, and, by Admiralty Circular, water is computed at 210 gallons to a ton. The boat, consequently, stows 2,404 gallons, or nearly 11½ tons.

Hoist out empty casks by a toggle in the bunghole; the toggle attached to chain or rope legs of unequal lengths, that the casks may hang clear of each other.

Under some circumstances, ships may water expeditiously by means of a guess-warp from the

to the shore, unreeving the running gear, and ing it together, when the distance is considerable, he boats warping up thereby.

3. KNOT IN A HAWSER, UNDER THE CIRCUMSTANCES RIBED.—Open it out, and pass the boat through it. actually happened in a ship that I belonged to.

4. CANVAS TANKS—Are supplied to nearly all ships, re made to fit under the thwarts of a launch, it is a cleaner and safer plan than watering in bulk, ugh the boat will not bring quite so much water on l at a time. The tanks when done with, are usually p by a whip on the foreyard, until dry.

5. BRINGING OFF WATER IN BULK.—See the boat and free from leaks, pump some fresh water into her ight before, but dry the boat out before sending her ; and keep the bottom-boards, and a few oars or rts loose in her, to prevent the water surging about she is loaded.

6. RAFTING WATER OFF.—Knock the outer hoops ch end of the casks, and drive them on again with a et underneath, for a hauling-line to pass through een the beach and the boats anchored outside the If not worth while to fit beckets, you may sling the instead. Parbuckle them into the boats, over the , if the water is smooth, and pull on board.

7. BOATS' RAIN-AWNINGS.—Fit three or four stretchers ch side, to step in the bottom of the boat, lash down

to the gunwale, and project two or three feet beyond it. Through a thimble seized to the end of these outriggers, or through a hole bored in them, reeve the ridge-rope, and set it taut up. Then haul the awning out to the stanchions (which must be of good height), and the side stops to the ridge-rope. It may also be worth while to fit a curtain in addition.

When the rain is over, and the awning made up, this ridge-rope, with the outriggers kept fast, forms a capital clothes-line for drying your wet things on, and ought not at any time to interfere with the oars.

498. BOAT STANDING FOR THE SHIP AND UNABLE TO FETCH UP.—The safe plan is to send a boat away with a small hawser to meet her, and then haul up both together, giving way at the same time. This saves a vast amount of trouble in the end, for, when a boat-rope is veered by a breaker, it requires buoying up at intervals to keep the bight from sinking, and even then will be carried very slowly astern—to add, probably, another proof to the universal proposition, that *half-measures are always failures*.

A small coir hawser should be kept (with a breaker attached to it) aft, on the upper deck of every ship, it will be found to save endless trouble with boats in a tide-way.

499. CAUGHT IN A FOG, AFTER TOWING A SHIP OUT OF HARBOUR.—Go on board the ship you have been towing, and take the bearing of the harbour, which you know from the course you have been steering: note the relative di

tion of the wind, if it is steady, and shove off, keeping on the same bearing till you get inshore or fetch the harbour. Should there be no wind, from the boats in line, making for the harbour, when, if each boat keeps in the wake of his leader, the leading boat will be enabled, by keeping the line directly astern of him, to steer a straight course for their destination. The soundings, also, will show you whether you are approaching or pulling away from the shore; and, if the ship will heave to, and fire guns at intervals till you have time to get in, you cannot well go wrong.

500. SENT AWAY TO SET FIRE TO A SHIP OR BUILDINGS.—Take with you a lighted slow-match, and a port-fire. (A port-fire requires scraping on the top, but you can ignite it with a slow-match.) If you are away without powder, the quickest way of making a fire is by mixing a couple of cartridges up into a *devil*, and setting fire to it by means of a piece of paper, smeared over with wet powder, fired out of a musket with a half charge. A cap stuck on the point of a knife, with a piece of this touch-paper, in it, will ignite the latter if struck against anything dry, when the report of the musket would be inconvenient.

501. A GALE OF WIND IN AN OPEN BOAT.—Lash your masts, bottom-boards, and oars together; hang the boat's anchor to them, to weight them; span them with the boat's hawser, and pitch them overboard. This will not only keep you head on to the sea, and form a breakwater, but will prevent you drifting so fast. Pass the other

end of the hawser round the boat outside, guy it dow here and there, by passing the bight of a rope over th bows, and slipping it aft under the bottom; lay the sa over the fore part of the boat, and lace them down outsi to the hawser; raise the after part up a little by sticking stretcher up under it, and you will thus keep the seas fro breaking into the boat, and have a shelter from th weather. Bung the breakers well up, run a piece of ro through the beckets to form a life-buoy, and keep the bo baled out.

502. "WATER, WATER, EVERYWHERE; AND NOT A DROP TO DRINK."—Twice a day dip your clothes over-board, and put them on wet.

503. LANDING, AND GETTING OFF IN A SURF.—Pull up to the rollers, and, if you are not going to beach her, let go the anchor, back astern, and go in after the third, which is the heaviest one, jerking the looms of your oars down to keep the blades out of the water. Let those who intend to land jump out as soon as possible, toss your oars in, and haul out through the surf before the next heavy sea comes in; if you are going to remain, go in of course bow first, jumping out and hauling the boat up before a sea comes over the stern and fills her. A steer oar through a grummet in the stern-ring should be used, as the rudder cannot be relied on. The best surf-boat is a whaler with *paddles*.

504. TRACKING.—Land all but one hand to steer the boat; pass your grapnel out, and track her up. If you have

to go, make tracking belts to go over the shoulder, any small stuff you may have in the boat, and hitch em to the boat-rope;—slipping the bight into the fore-most rowlock, if, from the shallowness of the water, it is necessary to track at a broad sheer.

505. CAUGHT IN A SQUALL.—Down with the helm and row her up into the wind, without waiting for the sheet be let go, although there may be a hand attending it; an lower away and reef.

506. FIRE-ARMS.—Before returning on board, be most rticular in seeing all the rifles unloaded; for innumerable ve been the accidents resulting from passing loaded fire-ms up a ship's side.

507. HOISTING BULLOCKS IN.—Hook on the yard and ıy to a strop round the beast's neck, putting his fore leg rough it to prevent it choking him. Cattle should be isted in by the horns only when the latter are very ong, and the animals themselves very small.

508. HOISTING HORSES IN.—If troublesome, cover his es, hobble him, and sling him with a broad mat, or canvas ngs, under his belly; with a crupper from his haunches nd the chest, to keep the slings from shifting. Lead halter through a ring-bolt on deck, and take the slack ough as he comes in. A strop round the nose, hove it with a short stick or toggle, will rapidly tame an

unmanageable horse.* Horses should be kept sl
their stalls at sea, with their hoofs just resting on th

509. UP-ENDING A LARGE CASK.—Lay a capst
under the bilge on each side, span them togethe
the chimes of the cask, at each end; man the b
up with it, sticking to it on the opposite side to
it going over.

510. CONDEMNED ROPE—Is returned into stor
fathom lengths.

511. MOUNTING A 64-PR. GUN WITH ITS OWN T
—The side and train-tackles supply you with near
fathoms of three-inch rope, which is capable of su
a weight, *suspended to it*, of 50 cwt. Therefore
possible to apply the power necessary to lift the
three parts of rope attached to it, their can be no
their capability to sustain it, more especially when
as a parbuckle.

If the gun is lying with the vent up, scoop th

* To see how defective all rules and specific directions
unless seconded by mother-wit and dexterity, read this
anecdote of an embarkation of horses on board the "Ganges

"One horse," writes the 'Staff Officer,' "would not a
slings to be put under him, and kept on lashing out with
leg in a most furious manner (it was too rough for him to l
both, as he would have fallen). This beast was dela
embarkation of the other horses; so one sailor called out
next time he kicks lay hold of his leg!' which Jack very cc
and, to our utter astonishment, the horse stood perfectly s
only snorted; in another second he was swinging in the a
way up the ship's side.

from under one of the trunnions, and roll it over with vent down. Lift the carriage on the top, lock the cap-ures, reeve and middle the breeching, pass the ends r the rear axle-trees, and secure it so as to confine the ch to the carriage; then haul over the latter on at. Hitch the side-tackles to the upper fore axle-tree, the train-tackle to the rear axle-tree, and reeve under the carriage and over the gun. Clap on all parts as many hands as can get hold, assist with the spikes on the opposite side and rouse away, chocking p with stones at every inch you get.

2 GETTING A GUN UP A HEIGHT.—Dismount the as you mounted her, easing her over by a hawser d the opposite way, and landing the breech and le on some large stones to keep her off the ground. unlash the carriage, and wedge the gun up in a cask, ding staves round it beyond the cask, and making it und as possible. Parbuckle it up with the hawsers, haul the carriage up afterwards.

13. PLACING HEAVY GUNS IN A LAUNCH FOR LANDING. ut a spar or oak plank, to lie on the gunwale inside the r streaks, over the after-thwart; and place a couple of s fore-and-aft, resting on this and on the stern. Land guns athwart these, and stow the carriages and gear ard.

14. MOUNTING THEM WITH A SMALL TRIANGLE OR .—Hook the tackle to a strop through the neck-ring, weigh the breech off the ground high enough to allow carriage to be run up with the trunnion-boxes under

the trunnions, the muzzle still resting on the ground; lower away roundly, and the gun falls into its place.

515. A PARBUCKLE—May be worked on the bight on the end.

On the Bight.—Middle the hawser, pass the bight un the gun, haul back and slip it over a fixture; open ends out under the gun, to keep it square, and walk a with it.

On the End.—When you have nothing to make bight fast to in the direction in which you want to mo the gun, middle the hawser (or less, according to the d tance to be moved over), and take two or three turns rou the gun amidships; then let a few hands hold back on t underneath end, which is taken up as the part yo haul on comes off,—the hands that hold on the end follo ing the gun up at the same time. Skids must be la along, to keep the trunnions off the ground.

When a gun has to be taken a considerable distanc slue it vent up, bend on to the neck-ring, and clap o plenty of hands.

516. FIGHTING A GUN WITHOUT A CARRIAGE.—Rig triangle, sling the gun round the trunnions and over th button, hooking on the purchase so as to give the required elevation, in which it has an advantage over a carriage, inasmuch as there is no limit to it. To check the recoil, reeve the breeching through a block or thimble on two legs of the triangle, with a large net full of shot slung to the ends. Sheer-head guys will perhaps be found necessary.

otherwise, build the trunnions up, and regulate the ration by a small triangle over the breech. But by this n you can only fire at a fixed object, as the direction not be altered.

517. LANDING FIELD-PIECE FOR EXERCISE.—Haul the t up alongside, and place the large end of a capstan on the gunwale on each side of the stem, projecting a t or two over, the inner ends being secured. Hoist gun out, ready mounted, on the field-carriage, and the axle-tree across the capstan bars, outside the , with the wheels on each bow. Bear down on the , and lash it to a thwart. Place the limber in the n-sheets, and afterwards hoist the boxes over.

On reaching the shore, land the field-piece party, hook the drag-ropes and man them, launch the capstan bars , and plant them as skids, lashing the inner ends to event them slipping. Bend a rope's-end to the trail to e it down by. Haul away on the drag-ropes hand- ely until the wheels take the ground, and then run the n up. Pass out the boxes and land the limber.

518. IN THE FACE OF AN ENEMY.—Fight the gun on slide in the boat as long as it is available, land the vering party, cease firing, in tompion and vent-plug, eeve the breeching, slip a short strop over the breech d another over the muzzle, bringing them together at the nnions, carry aft the runners of the foremast, top the owsprit up for a derrick (previously fitted for that rpose), hook a tackle from the derrick-head to the strops,

bend a drag-rope to the breech-ring, whip the
drag it ashore and mount it. Hands in the m
have got the carriage and limber ashore and r
wheels having been slung outside the boat, the
limber fore-and-aft, and the boxes in the stern-she
Boat-keepers haul the boat off to her anchor,
line ashore to haul in by when wanted.

519. HOISTING IN GUNS.—The gun you wish
in is an 8-inch, and weighs 9 tons. Top the m
and brace it, so that it will plumb the port or l
through which the gun has to go ; put burtons on
as preventer lifts, haul the lifts, preventer lifts,
braces, and topsail sheets well taut, lash the bun
main yard to the mast with a cross lashing, hoc
tackle on the opposite side to the rolling tackle st
to another strop round the mast, haul it taut. La
block on to the yard far enough out to allow the
clear the ship's side while hoisting ; take the e
7-inch or 8-inch hawser from the opposite side of t
over the lower cap, and through the block lashed
yard, then take the end on deck and secure tc
upper block of your yard purchase, round it up suf
high, and secure the hawser on deck, well pa
hawser in the wake of the cap, and wherever it i
to chafe.

For both yard and stay purchases, two three-fold
must be used, with five or six inch falls rove in th
hauling parts should be led through leading bl

t-head before going on deck; top-tackle blocks ısed for the purchase blocks.

ɟun is slung with a chain strop, having a seizing on ht, leaving an eye large enough to fit over the ɟf the gun; the other bight to which the purchase ıre hooked, is well lashed to the gun outside the ıs.

ɑain hatchway of ships carrying heavy guns on the ck, is generally fitted with moveable combings or ıtes, that fit across the hatchway, allowing the to be placed so that the gun can be lowered into ıce; great care should be taken in transporting to its port, or you will find the deck much cut ıe iron carriage.*

ɟuns under 6½ tons in weight, secure the main you would to hoist in a launch. Reeve the end -tackle pendant through a top block, take the end lower cap and secure it on deck, lash an up-and- ıckle to the main yard arm, and to the top block pendant to be used as an outhaul; reeve a top- ıll, hook the upper block to the pendant, and lead ing part through a leading block on the strop of er block; through another at the cap, and then on

f the Gun in through a Port.—When slinging the ɔw a good drift outside the lashing, to give play to

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* *To hoist in heavier guns, see answer number 534.*

the gun when the purchase block binds against the upper port-sill; line the port, to prevent injury to it, hook the purchase, and hoist away. When up to the port, ease in the up-and-down, pass the gurnet out, and hook it to the neck-ring, haul in on the gurnet, ease away the purchase, and land the gun on the carriage run up to receive it. Unhook, and overhaul down for the next.

The gurnet—consists of a pendant and tackle, and is best fitted so that it can be worked under the eye of the officer superintending the mounting, and for this purpose, a clump-block with a double strop should be fitted, and the bights either slipped over the dismounting bolts or toggled through the deck. The end of the pendant is fitted with a hook or shackle to take the neck ring of the gun.

Boats guns are slung with their breechings, and hoisted in with the yard tackles.

520. To Calculate the Weight of a Gun.—Rule. Divide the gun into as many sections as its form requires, to enable you to obtain the true dimensions, and ascertain the weight of each part separately. To do this:

1st. Find the area of the base of the cylinder, by multiplying the square of the diameter by ·7854; or by multiplying the square of the circumference by ·07958.

2nd. To find the solidity of the cylinder, multiply the area into its length.

3rd. Add the contents of each section thus found, for the whole contents of the cylinder, supposing it to be solid mass.

4th. In the same manner find the contents of the bore of the gun, assuming it to be a solid cylinder.

5th. Subtract this from the solid contents of the gun, previously found, to obtain the actual contents, and—

6th. By Table VIII, obtain the weight of a mass of metal of the dimensions ascertained.

$7'125^2 \times \cdot07958 \times 8'5 = 34'34$ ft. Contents of 1st section, from base to trunnions.

$6'146^2 \times \cdot07958 \times 11'333 = 34'06$ ft. Contents of 2nd section, from trunnions to muzzle.

$1'75^2 \times \cdot7854 \times 19'833 = 8'75$ ft. Contents of bore.

$68'4 - 8'75 = 59'65$ ft. Cubic contents of gun.

$59'65 \times 524'8 + 5$ cwt. $= 14$ tons, $4'5$ cwt. Total weight of gun.

521. To find the Solid Contents of a Sphere.—Multiply the cube of the diameter by ·5236; or the cube of the circumference by ·01688, and, by Table VIII, find the weight.

$8'7^3 \times \cdot5226 \times 4'171 = 90$ lbs. Weight of the shot.

522. Getting a New Mast in by the old one.—Let the mast be 128 feet long; viz., 40 feet from the heel to deck, 67 feet from deck to trestle-trees, and 21 feet the length of the head. Diameter, 40 inches; and weight, 20 tons.

Get the main yard, lower cap, and top on deck; fish the mast where the decay or spring has taken place, and

on that side—say port side—prepare to get the new

a. Upper purchase.
b. Main purchase.
c. Lower purchase.
d. Heel-tackles.
e. Mast-head guys.

in. Set
stays and
board r
well up;
runner
tackle o
fore and
side of th
head, set
up well fo
and aft c
port side
deck, and
up the
rigging.
the purc
above th
ging, taki
the main
chase the
and thre
purchase l
with the
inch sh
hawser fo
fall; and
the upper purchase, two three-fold top-tackle blocks
a fall of 6½ inches. Bring the new mast alongside
the head forward; lash the main purchase a little

the centre (of gravity), towards the head, and the upper purchase half-way from that towards the heel. Sway the mast up clear of the main chains by the upper purchase (capable of lifting 40 tons), rousing it forward by a tackle if necessary; and then, with both, sway the mast up square. Haul it inboard by hawsers from the main-deck ports, and land it on the deck.

Slack up the main rigging, and saw the mast through close off to the deck, wedging it up as the saw enters. Shore the deck up most carefully abaft the mast; place a mould for the heel level with the line of section, and nail it down, as it would be impossible to cut it off quite close to the deck. Get powerful deck-tackles on the heel, reeve appropriate mast-head guys, overhaul the rigging, and fleet the mast abaft the mast-hole. Set the rigging up again, shortening up the after-shrouds, if necessary, and support the mast further with the fore and main runners and tackles, two forward and two aft; and secure the heel in its place by shores, fore-and-aft and athwartships, from the hatch-ways and ship's side. Nail a large bolster across the trestle-trees, on the fore side of the mast, for the purchase-block strops to lie on, that the blocks and falls may not bind against the mast. Relash the purchases, with a lower purchase in addition, similar to the upper one, hanging down well clear of the main purchase. Sling the stump of the old mast, and hoist it out. Lash the strops upon the new mast,—that for the lower purchase, about twenty feet from the heel; main purchase about 45 feet from the heel; upper purchase about 50 feet from the head; strops for heel-tackles a foot or two clear; all well cleated.

Over the mast-head, middle and hitch a couple of hawsers; take two ends forward and two aft; tog main and upper purchases, bring them to the ma lower-deck capstans, and heave round. When high to need it, hook to the heel six up-and-downs, or lu attend them and the mast-head guys carefully as t goes up. When the upper purchase comes two stopper, and belay it to the bitts; toggle and brin lower purchase, heave round, and ease away the purchase. Rouse the heel over the mast-hole, an back, with the mast-head guys manned, and heel ready between decks. Unrig the old mast, and out with the new one.

523. GETTING MAIN YARD FORE-AND-AFT THE —Coming down port side. The ordinary plan is yard to starboard, by a sail-tackle from the topmas hauling forward on the preventer brace and lower jeers, to clear the top rim; hauling aft by mizen bu port yard-arm, and then with a luff on starboard ya rousing it over into the gangway, when lowered c the main stays.

In a ship with short lower masts, it may l that there is not sufficient drift for the yard-a come in over the nettings or through the gangw which case, having rove the jeers, unrove the after unbent the sail, and sent the booms down, you h tackle to the bunt of the yard from the starboard the forecastle, and, alongside it, a runner and tackl the foremast head, the pendant being taken under t

d secured close down to the eyes of the rigging. To a
up round the starboard yard-arm hook the port up-and-
wn inside the quarter-iron, and outside the quarter-iron,
the port yard-arm, hook the port main tackle: these
pport the yard-arms when fore and aft, and the lifts are
ove. From the port fore rigging, hook a burton to the
rboard yard-arm, where the fore tackle is attached.
en heave taut the jeers, off slip, turn out the trusses,
d lower the yard partly down, rousing it bodily forward
the runner and tackle, and bracing the starboard yard-
m inside the fore rigging by the burton and preventer
ce; turn with the runner, walk back the jeers, and haul
rward on the fore-and-after till the port yard-arm is clear
f main rigging and mainmast, attending, at the same time,
the fore and main tackles; rouse the yard-arm over by a
f, lower of all, and land the yard, allowing it to come aft
far as convenient.

524. UNBENDING SAILS.—Words of command.—"Un-
nd sails." "Away aloft." "Lay out on the lower yards
nd unclamp." (Laying in again.) "Trice up—lay out."
'Ease in." "Stand by booms and buntlines." "Sails and
ooms—lower away."

If top-gallant and royal yards are across, yards, sails,
nd booms may be lowered together.

525. SHIFTING BOWSPRIT CAP—Rig the jib-boom
ree-fourths in, and pass a lashing round the head and
eel to keep it in its place when the cap comes off; pull
on the sail-tackle (from mast-head to boom-end), to

take the weight of the cap when it is started: unreeve the heel-rope, sling a spar on each side of the bowsprit, lash a couple of leading-blocks to the jib-boom, close to the cap, and through them reeve a rope's end to the heel of the spars; with these, bump the cap off, the bolt, which secures it to the bowsprit (fore-locked on the top, abaft the foremost hoop), being driven out; carpenter's assisting with their mauls. When off, sling it, rig the boom in altogether, and hoist the cap in with a couple of luffs on the fore stay, the sail-burton taken off the boom, and with the fore up-and-down.

Or, it may be got off by drooping a pair of sheers formed of topmast studding-sail booms, supported by a sail-tackle from the mast-head, the heels stepped on the bees, and the cap slung, while being bumped off, by a couple of luffs from the sheer-heads; and transported in as before. In this manner, it may also be sent out, and placed again.

The jib-boom may be used for getting the cap on, by resting the heel against the stem, topping it up with the sail-burton, and swaying the cap up by a tackle from the boom-end.

Or, it may be sent out as far as the collars of the fore stays by the luffs, and there lashed to a topmast studding-sail boom pointed through the round hole; a guy on each side taken to it from the cat-heads, the sail-tackle hooked to the end of the boom and pulled up, and the boom rigged out by heel-ropes—easing the guys and sail-tackle.

SHIFTING BOWSPRIT.—A bowsprit may be got out ith a main topmast as a derrick, or with the two nasts as sheers. If by the latter means, strike the nast and land it on deck; get the spare one up e of it by an up-and-down; open out the heels— n shoes, cross the heads and lash them. Secure nast with runners and tackles, strip the bowsprit, se main and mizen topmasts. Lash a top-block to rs'-head for the topping-lift, and a couple of blocks ore-mast-head just above the rigging, so that they r the top when the topping-lift is rove, using for it ı hawser, with the standing part secured to the ead.

a three-fold top-tackle block at the sheers'-head, 'e the main jeers for a purchase, the lower block ither a top-tackle or a cat-block. Secure the of the launch's purchase to the foremast-head, over the sheers'-head, so that the block will be ı when they are drooped, and lash it out on the ten or twelve feet inside the cap, for a cap pur- turn or two of the lashing being taken to the cap, to it slipping in. Lash the purchase out between monings; two or three turns round the bowsprit g taken over the hook of the purchase block, in jamb the lashing. Mark the bowsprit where the ead should plumb when drooped sufficiently, ıould be as far outside the lashing as the bowsprit nboard. Haul forward on the purchase and droop rs till a plumb-line from the purchase block comes

1857, H.M.S. "Nankin," 50, was employed in
; the wreck of the "Raleigh," 50, sunk off Macao;
nable to start the wedges of the masts, as the water
e upper deck port-sills, and never fell at low
w four feet on the main deck, they were
attempt what most men would have considered
bility; and to the great credit of those officers
ankin" on whom the duty devolved, they suc-
th sheers formed of the "Raleigh's" main top-
rawing the lower masts through orlop, lower,
deck wedges, and in getting them overboard
accident.

ıeers are very disproportionate to the length of
ɔu are getting out, the purchase would be two
:n the heel but just clears the upper-deck part-
ou would not be able to take it higher on
the great top weight: it consequently would be
clear the upper works unless lowered in an
ɔs direction, and then roused over bodily before
ıe heel. This, however, would be a work of
er and difficulty, as the heel-tackles would be
ınd the whole leverage of the top-weight thrown
per purchase. Under such circumstances, the
ld be sent over on the opposite side, head
; easing up the head-tackles and lowering the

ING OUT A PADDLE SLOOP'S PINNACE.—The
-th a fore-and-aft span, and lifted by a stay-
span between the fore and main-masts,

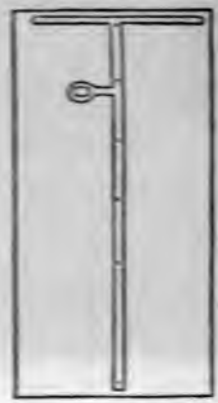
plumbing the boat; then hauled out by the fore-yard pu chase, either before or abaft the fore rigging, according the position of the paddle-box. In addition to the bu tons, the fore yard is secured by a preventer brace fro the bowsprit.

529. HOISTING IN A LONG SPAR.—Trice up yard an stay-tackles, cross the stays, and brace the yards in; pu up the after end best, until the foremost end is inside th fore rigging, backstays being frapped in; then lower th after end, and haul forward.

530. HOGGING SHIP.—Wedge a large grating full c broom stuff; bend a weight to the bight of a hawser, an dip it under the ship's bottom; haul up on one end an bend on the hog at the bight. Reeve a hawser, inboard through a block on the bowsprit and spanker-boom ends, and bend the ends to the hog; give the thwartships hawser into a boom-boat on each side; and if the hog is over the starboard side, and you are going to hog that side first, let the port boat haul up on the hawser until the hog is brought close down to the keel, and, when down, and a taut turn has been taken in both boats, man the fore-and-after and walk it forward and aft the whole length of the ship. The port boat then eases up the breadth of the hog, the starboard boat takes in the slack, the fore-and-after is hauled on, and another longitudinal section cleaned, and so on with both sides. By heeling the ship over, you may clean a short distance below the water-line by means of small hogs with poles stuck into them.

1. INTERNAL ECONOMY, &c.—HAMMOCKS.—As the ness of the hammocks adds as much to a ship's appear- as their slovenly condition detracts from it, it is ne- ry that they should be carefully inspected by the mid- nen stationed to nettings, previous to being stowed. ermit of this, the men, on coming on deck, should n abreast of their nettings in the rear of each other, rding to their numbers; the foremost hammock of netting always commencing with the same number he watch bill, and continuing consecutively, the men ing rank, and closing up as the foremost hammocks passed in. The first turn of the lashing should be through two holes in the tabling, close to the midship ; no wrinkles allowed in the head, nor in any other of the hammock; the ends of the nettles carefully along, and hitched over inside, and a twist taken in clews and hauled taut along the hammock by the rd of the opposite clew. A hand should attend the while stowing; and the lashings of the waist ham- s should form one uniform line, inside and out, by g squared after they are stowed.

o insure regularity in the distance of the turns, and in position of the numbers, an iron scale should be used that in the cut. It is there placed on a starboard h's hammock, and must be turned over to mark those he port watch. Seven holes are punched in it, where s on the seam; and when these, with the oval for the ber, are pencilled round, the scale is removed. A h or two is then passed through the seven dotted



marks, which show, when
up, where the turns should
and the patch is painted wit
numbers, on a white ground b
with a black line, for one
hammocks; and with whit
bers, on a black ground b
with a white line, for the
set Two good stops, w
should be spliced into the
each hammock, and two in t
for stopping to the gantlin
centre stop for the head being a fixture in the gantl

When hammocks have a tendency to excee
stipulated dimensions, a hoop is held for the han
to be passed through as they are stowed.

On piping down when hammocks have been c
the men, after taking them below, should return or
and form in line round the ship facing the nettings,
of where their hammocks have been stowed, ready
the nettings for furling, when they have been r
clear by the young gentlemen stationed to them.

MIDSHIPMEN'S DUTIES.—While touching on this
I am reminded of a very laconic, but comprehensi
mary, issued by the captain for their guidance, in a
some note.

"Their duties," it ran, "in one sentence, are t
they are ordered, in a smart and intelligent manne

hey are to see all orders carried into effect. That ien are at their stations. That they perform the of their stations. That all ropes are coiled down y they are belayed. That all dirt, or spots on the are instantly removed. That rope-yarns, or other h, are removed from wherever they may have ed to accumulate.

hen sent on duty, they are never to quit that duty. are never to leave their boats, nor suffer any of their to do so. They are not to allow spirits or wine to be ht to their boats' crews; and are to report any man nay have misbehaved.

hey are at all times to appear properly dressed, and) avoid incurring debt.

hey are constantly to keep in mind that, unless they act themselves to my satisfaction, they will not receive tificate; without which, when the time arrives, they not be examined touching their qualifications for a nission."

rthermore, the officer of the watch is ordered by the ain "on all occasions to be most strict with the mid- men, and is authorized to punish either of them by g them an extra watch for any fault not sufficiently e for him to interfere with." The officer of the watch so directed "not to allow the midshipmen of strange s to remain on board after they have delivered their ages, but to make them lie off, or hang on to the ."

The first lieutenant is to "take care that the
strictly under instruction during school-hours;
are never to have leave unless they are clear of
unless they perform their duties in a diligent an
manner."

The character of a ship can always be told by
and boats' crews; therefore the officer of a b
not only consider himself answerable for her clea
good order, but that the crew are properly dresse
and respectful, and that they *always give way*,—
same example of respect to officers of other
would be required of him and his men by those c
As a general rule, boats are better manned ar
from booms, instead of from the gangways. U
nary circumstances, every man should be on
minute from the pipe; and the first person up
the midshipman of the boat.

As midshipman of a top, he should exert l
maintain the most perfect silence; to see, in fur
that the men keep within the marks which s
painted on the yards, until ordered to lay out;
as they come in off the yards, none land in the t
the men stationed there for squaring yards. As tl
should not be lowered until every man is in, he sl
that the quarters of the yards are smartly cleared,
way for the outside hands, with the exception of
one man, who remains out to foot the boom cl
reefing, he should be particularly careful that th
hooks and tricing-lines are properly attended, and

nted until every man is in. In crossing yards, and rtening sail, that the squaring marks of lifts are expe- ously got down; and, on all occasions, that a *second* l from the deck is never necessary.

As midshipman of the watch, he is to have his watch l always with him: and, as it should be a standing er that no man is to *walk* when called, working ship, , so the young gentleman should at all times set the mple of a like prompt and ready obedience. On the ool a youngster is brought up in, his future character pends.

To mates of decks the following receipts may be of use:—

For guns.—4 oz. resin, 2 oz. lamp-black, 3 oz. bees- x (2 oz. shellac), 1 quart linseed oil. Boiled 50 minutes, d, when taken off, half a pint turpentine added.

This is to be laid on as a first coat, and afterwards kept with ordinary bees-wax and turpentine. For bronzed s, omit the lamp-black, and previously apply a solu- n of sal-ammoniac, after scraping.

White varnish for range-tables, &c.—White resin and rpentine, dissolved in a close bottle, placed in hot water a stove.

Cement for cracks in woodwork, &c.—Four parts of bees-wax to one of resin, melted together, and tinted with Indian red and yellow ochre.

Leather belts, &c., may be stained black with a solution of copperas.

For steamers' funnels, the same in whitewash turns it a buff colour.

Varnish for spars.—Boiled linseed oil and resin, warmed till the resin is dissolved.

Mast colour.—Dockyard-yellow, a little white, and warmed up with Venetian red.

Black stain.—Into a breaker put 2 lbs. copperas, 2 lbs. nut-gall, 8 lbs. alum, pounded up ; 8 lbs. old iron, and 25 pints of vinegar. When wanted, boil as much as is required and lay on hot. It is better to make a large quantity at first, as the longer it is kept the better it becomes. Three or four coats are necessary.

French polish.—5 oz. naphtha, 1 oz. shellac, 10 grains of isinglass, 1 dram of myrrh, and 6 drams of olive oil.

Whitewash.—The best is made from quicklime, for it will not rub off, and if kept in a tank, there can be no danger from it. To keep whitewash in good order, all marks should be rubbed out, and the whole smoothed down with hard canvas rubbers on sticks, before going over it at any time.

Scraping masts and booms.—Instead of going through the scraping process every Saturday, and covering your deck with chips, send the booms down on deck when they want it, and scrub them with sand and canvas; both lowering them down, and swaying them across together. The dirt should merely be scraped off the top-gallant masts as an ordinary practice, and a light plane-over given to

[redacted]m at long intervals after a general refit, which is in [redacted]itely less injurious to them, at any time, than scraping [redacted]h knives.

Though the "watch-mark" on the arm is usually a suffi[redacted]nt indication; "Which watch on deck?" is a question [redacted]n asked when the hands are employed; therefore have [redacted]brass S or P hung upon the wheel, and turned at the [redacted]d of every watch.

Washing-tubs.—The lower hoops should be knocked up [redacted] inch or two, when drawn, or your decks will be marked.

A large dirt-tub on the main deck, to collect the rubbish [redacted]all decks, whipped up at the end of each watch, and [redacted]sized with a slip-toggle, is far better than a head-shoot [redacted]gling from the bows.

Holystoning, *too frequently*, makes the deck rough. A [redacted]inkle and scrub at seven bells in the forenoon, with [redacted]nd-brushes, cloths, or hand-swabs, dries rapidly in warm [redacted]ather, and renders it less necessary.

Instead of lowering the duty cutters on alternate days, [redacted]eep each at the davits for a week at a time. On Saturday, [redacted]keep the boat up that has done duty for the week; clean, [redacted]and paint her bottom, if it requires it: and you have then [redacted]the ensuing week to touch her up and put her to rights [redacted]ready for relieving the other cutter. With boom-boats the [redacted]same; for, if they are worked indiscriminately, they can [redacted]never be kept in proper order.

In a small vessel never be induced to advocate the re[redacted]linquishment of mess-tables and stools. Men sprawling

on the deck among their beef and pork has a dirty, demoralizing effect; which has only to be witnessed to convince one of.

Saturday being the great cleaning and renovating day, it is a good plan to muster the watch in the morning in their clean working rig, duck jumper and trowsers (the coaling rig of steamers), which though tarred and stained, may nevertheless be kept scrupulously clean.

Sunday, the blessed day of rest, is too frequently a day of bustling, fatiguing duties, and the most undesired of all the seven. From the hour of commencing work in the early morning, until the pipe to dinner at last releases you there is often no cessation. To those on whom the work of the ship devolves, Divine service is no relief, for it is then felt to be part of a relentless routine that has to be gone through, and they are only too glad when what, week after week, seems an interminable repetition, is brought to a close. I know of no remedy for this serious evil short of a total change in the character of the day, as it is at present viewed. Instead of looking upon it as the first day of a new week, with your hands clear until the work of the week on the morrow commences, it is generally considered the winding-up day of the previous week, when all its accumulated details have to be examined and gone into. On Sunday, the paymaster makes up his books, and gives in his report; warrant-officers' accounts and midshipmen's logs are written up and sent in; defaulter's book and defaulters examined; Articles of War read; ship's company mustered by open list; and the

ip—decks, holds, and store-rooms, minutely and
r inspected, after a laborious preparation, which
llowed up by a lengthened service of prayer and

the above necessary duties are transferred to
lay, Thursday for instance, I cannot see how the
ature of the Sabbath is to be maintained.
ing decks and crossing upper yards, on Sunday
may now be counted as things of the past;
be consistent in this, the rigorous Sunday
n, with its jading, temper-breaking preludes and
niments, should be simplified as much as possible.
eans muster at divisions: but leave the general
n of the ship for a week-day. *A well-regulated ship ways be ready*; but the usual Sunday spruceness,
at so great a sacrifice, is frequently on a great
n, and by it, that which is known by the name of
Service," is rendered a soulless and compulsory
acting. Under such circumstances, no one for a
can imagine that men, who from their habits are
naccustomed to any but the briefest contemplation
cted thought on abstract subjects, can give their
r an hour and a half, to the devotions they are
d to take a part in. Of course, such a startling
bility *is* not entertained by any one, and we are
driven to the conclusion that "Divine Service"
nly maintained for the mere sake of keeping up
ices, and to be in accordance with the "Articles

I would beg of my young readers to treasure up, abide by those few wise words, which, often quoted, known as "the golden maxim" of the great Sir Matt Hale :—

A Sunday well spent,
Brings a week of content,
And health for the toils of the morrow;
But a Sabbath profaned,
Whatsoe'er may be gained,
Is a certain forerunner of sorrow.

He made this his rule of life, and hear what he sa it was drawing on to its close :—

"I have found by a strict and diligent observation a due observation of the duty of this day, hath ever j to it a blessing upon the rest of my time; and the that hath been so begun, hath been blessed and prosp to me : and on the other side, when I have been negl of the duties of this day, the rest of the week hath unsuccessful and unhappy to my own secular employn and this I do not write lightly or inconsiderately upon a long and sound observation and experience."

CAPITAL PUNISHMENT.—By the power of life and vested in courts-martial, the duty of carrying out th treme sentence of the law devolves upon the naval o Happily this is of so rare an occurrence, that few c conversant with the unattractive detail of the duty; from motives of humanity I think it right to expla It is a repulsive subject, and I may perhaps be consi guilty of very questionable taste in discussing it; b

object to that, should it happen at any time to tend
: furtherance of the service. The traditionary knot
le with a bight, as for a sheepshank, the end then
l round its own and all parts, passed through the
bight, which is then hauled down, and a running
formed. The whip is led through a block on the
lown through one on the fore yard-arm; the end
hanked with a hitch only round the lower bight, but
per bight seized to the standing part with a slight
stop. At six feet from the end, below the seizing,
le is seized, to cause the drop. The stop carries
on being brought up against the block, the sheep-
fall adrift, and the toggle, with a jerk bringing up
t the block, answers the purpose of "belay" to the
n the whip. The execution takes place when and
the commander-in-chief directs, but usually on board
ip in which the crime has been committed. The
of the fleet form round; the whip is manned by two
rom a boat of each ship (a lieutenant from each
ing), taken from whatever thwart in the boat that
ptain, superintending the duty, thinks fit to direct.
riminal being pinioned, is removed from irons, and
ht on deck under a guard; the sentence of the
martial, and article of war is read—the cap drawn
—the knot adjusted—the gun fired, and the sentence
ted.*

Osler's "Life of Lord Exmouth," among the many instances
stern energy of character, there is one related in connection
is subject, which I am led to extract, as much for the example

ORDER OF CONDUCTING FUNERALS.—*Of a Lieut*

Band.
100 Marines (firing party)—four abr
Relay of Seamen, to carry the Cof

Lieutenant. Lieut

Lieutenant. Lieut

Of the Ship { One other W. R. Officer } { One W. R.

Surgeon and Captain (Chief Mour
Boys—Midshipman in charge.
Seamen— ,, ,,
Petty Officers—Mate in charg
Warrant Officers.
Gun-room Officers.
Ward-room Officers.

Of the Squadron { Boats' Crews, attended by Boat Mid Officers.

Going—Juniors first. Returning, Seniors.

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it affords of mental intrepidity in the discharge of duty as fo
portunity it gives me of bringing that matchless biograph
notice of those who are strangers to the record of that g
good man's life.

"Considerate as he was upon all occasions when human
concerned, and unwilling to resort to punishment, he was alw
ious to make it as impressive as possible whenever it became r
to inflict it. He assisted to try one of the mutineers of the 'H
whose crime was attended with circumstances of peculiar agg

32. DRESSING SHIP.—There are ten numeral flags, ity-one alphabetical (thirteen square, and eight triangu- and twelve pendants, of which the answering and ier pendants are to be left out. The ship's number we assume to be R, union, N, which, with the ship's pen- t also, lay on one side, and divide the flags as follows:—

n flying-boom end to re top-gallant mast-ead,	8 pendants, and 7 square flags, alternately.
nce to main top-gal- nt mast-head,	4 square & 4 triangular flags, alternately.
nce to mizen top gal- nt mast-head,	3 square & 3 triangular flags, alternately.
nce to peak,	3 square flags.
nce to boom-end,	5 square flags

rom the spanker-boom end hang the ship's pendants, from the flying-boom end, the number; a lead attached

---

aptain Pigott having brought him up from a boy, and treated him i much kindness and confidence. His crime was fully proved; the court being cleared, Sir Edward proposed that sentence ild be executed immediately. The circumstances of the case de- ided, in his opinion, unusual severity, which might be expected ave a good effect upon the fleet; while there was every reason to clude, from the prisoner's demeanour before them, that if delay e allowed, he would meet his fate with a hardihood which would troy the value of the example. The court at first questioned their rer to execute without the warrant of the Admiralty, but this was kly settled by reference to the Act of Parliament. The president n declared that he could not make the order. 'Look here!' said giving to Sir Edward his hand, trembling violently, and bathed in a

to each to keep them from flying away. If the ship's number consist of two square flags, or two triangular flags, with the union, the necessary alteration can be made by substitution, between the main and mizen-masts.

Top-gallant yards are generally not sent down on the evening previous to dressing ship; but, should they be, cross them in the morning at seven bells. The flying jib and royal halyards are used to trice up by, rove through blocks at the mast-heads, with down-hauls attached; and the flags, in addition to being stopped at the head and tack, are stitched to the halyards amidships. Reeve them before breakfast, and bend the flags on; and at two min-

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cold perspiration. 'I see it, and I respect your feelings,' replied Sir Edward, 'but I am sure that such an example is wanted, and I must press the point.' 'Well,' he replied, 'if it be the *unanimous* opinion of the court, it shall be done.' It was agreed to, and the prisoner was called. Though sure that he must be condemned, he entered with a bold front; but when he was informed that he would be executed in one hour, he rolled on the cabin deck in an agony. 'What! gentlemen,' he exclaimed, 'hang me directly! will you not allow me a few days—a little time—to make my peace with God!' The whole fleet was appalled when the close of the court-martial was announced to them by the signal for execution; and at the end of the allotted hour, the wretched criminal was brought up to undergo his sentence.

"The clamour of that false humanity which is one of the most prominent vices of the present day would never influence him. Little consideration can be claimed for that pretended sense of honour which is sensitive to the degradation of punishnnent, but callous to that of crime."

ites before eight trice up mast-head ensigns, made up, and send aloft the captain of each top and two hands, one of whom, going to the mast-head, stops the tack in when broke; the other, remaining in the top, clears the flags, should they foul,

When dressing in honour of a foreign power, as in the case of salutes, neither custom nor the Queen's Regulations have determined at which mast-head the foreign colours should be displayed. Custom authorizing the fore or main, according to individual opinion, and the regulations only requiring it to be hoisted at "a mast-head," or at "one of the mast-heads;" courtesy would seem to require that the place of honour—the main top-gallant mast-head—should be given to it.

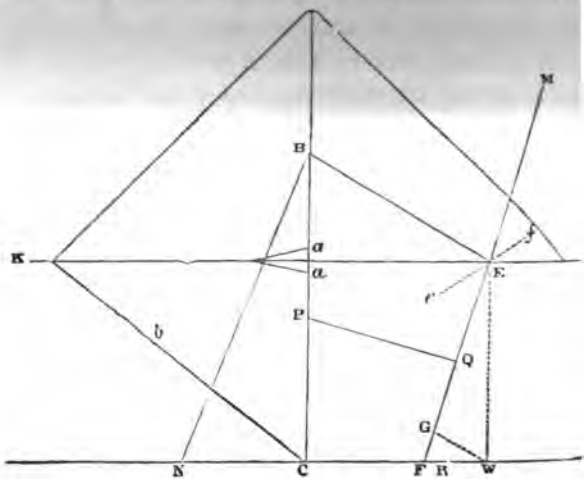
On a shift of wind, or at the turn of the tide if lying in a tideway, send hands aloft together to clear the flags.

533. Her Majesty's Birthday.—Dress ship, and on life-lines at 8 A.M. Noon, away aloft, lay out and fire the first gun of a royal salute. The salute over, the band plays the national anthem, all present standing with heads uncovered. When finished, three cheers for the Queen; then lay in, down from aloft, and off life-lines. When the ship is illuminated in the evening, lanterns are placed in all the ports, and hung at the yard-arms, mast-heads, &c.

Anchoring in a Foreign Port.—After the salute to the flag, of twenty-one guns, the admiral of the port is saluted, and if you think fit, the governor also; but, at the salute to the admiral, the jib is run up or fore topsail

loosed; hoisted, or let fall at the first gun; and ha
down, or picked up when over, This indicates a s
to some one afloat, but it is not always observed.

534. HOISTING IN HEAVY WEIGHTS.—A 30-ton g
mortar. Lower the main yard to a distance of forty
from the deck, clap a couple of stout anchor-strops o
lee quarter, cleat them up, and pass trustworthy lash
a, *a*, through the bights of the strop and round the n



overhaul the lee quarter-tackle, *b*, and hook it to a bolt
the partners. Hang the yard by up-and-downs from t
lower pendants, pass a cross-lashing round yard and ma
and unreeve the jeers.

Derrick.—Get the spare main topmast up, droop it
the proper angle, wedge the heel up and secure it, sho

e decks up, and lash the derrick with a cross-lashing to e after side of the main yard,—the lashing passed in the ection *e f*.

Topping lift.—Fish-fall, rove from the opposite side of e deck, through the fish-davit head block at the mast-d.

Derrick-head guys.—Main runners and tackles—forward aft; runners hitched round derrick-head and yard.

Shore, P. Q.—Mizen gaff. The jaws lashed upon the rick, and the peak to the mast with a cross-lashing and s through the peak-halyard bolts.

Belly guys.—Forward and aft. Up-and-down tackles h luffs on their falls; two to be hooked forward, the side one to be dipped outside the derrick purchase as e stay purchase is hauled on, and the midship one come p when the other is taut.

Derrick-head purchase.—Blocks, treble and fourfold 9-inch purchase blocks. Fall, 9-inch hawser.

Mast-head purchase.—Reeve two top-tackle pendants rough the top-blocks, pass the ends up through the hole r the slings on the fore part of the top, and secure them und the eyes of the rigging. Haul the top blocks out the derrick-head by a fish-fall, rove full; the hauling rt being led through a block at the mast-head. Reeve cat-fall through two cat-blocks for the purchase, trice it p and hook it to the pendants.

The main yard is used to prevent the derrick coming n when the stay purchase is hauled upon; and it also

acts as a cross-piece to the topmast, to prevent purchase slipping down. It consequently hangs fr being supported at the yard-arm by the topping-lift; the trifling strain brought upon it, being horizonta thrown upon the quarter and cross-lashings round mainmast.

To ascertain the strain the gear will have to bea off B C equal to the length of the mast from de trestle-trees, minus the drop of the topping-lift b which will be about 63 feet. Project the main yard, l at the calculated height from the deck, = 40 feet. l the derrick, F M, at the necessary angle, and po upon the deck, N R. Connect E B N, to represen topping-lift; and let fall E W, to represent the pur with the weight attached.

On the line E W lay off E W = 40 tons (weight + r ance in lifting, or 30 + one-third), and draw W G par to B E. Then G E will represent the pressure on derrick in the direction of its length, and G W the ten on the topping-lift E B. Measure G E and G W; an will be found that the derrick will have to support a st of 35 tons, and the topping-lift a strain of 12 tons.

To find, now, what the purchases, topping-lift, derrick are capable of bearing:—

Derrick-head purchase.—Seven parts of 9-inch haws minus the allowance for friction, by rule previously giv (Art. 32), are capable of *lifting* 73·5 tons.

Mast-head purchase.—Two pendants of 9-inch rope 39 tons. Fall, six parts of 6-inch = 39 tons.

Topping-lift.—Five parts of 5-inch = 23 tons.

To ascertain the strength of the derrick.—*

Least diameter of topmast, 20 inches	...	1·301030
		4
		5.204120
121	...	9·082785
		4·286905
Tab. No. Norway spars, 5830000...	...	6·765669
		1·052574
EQ, 21 ft. = 252 in. Squared ...	...	4·802802
	lbs.	6·249772
112 lbs. in cwt.	...	2·049218
	cwt.	4·200554
20 cwt. in ton	...	1·301030
4)793	tons	2·899524

198 tons = practical strength of derrick.

The whole length of the derrick, EG, is 42 feet; but, as it is securely held amidships by the shore and belly-guys, the distance between the supports is that alone affected by the strain. Without the shore and belly-guys, the derrick, by calculation, would only support a weight of 50 tons. And, as strength varies inversely with the square of the

* See page 389 par. 16.

length, $21^2 : 42^2 :: x : 198$. By this, also, $x = 50$ t
nearly.

Thrown into a tabular form it will be seen that th
are means for lifting any possible weight with ease a
safety.

Gear.	Capacity for strain: calculated at the minimum strength of materials.	Strain produced.
Derrick-head purchase	Fall.....73 tons (Blocks .....84 ,,)	40 tons.
Mast-head purchase ...	39 ,,	
Topping-lift	23 ,,	12 ,,
Derrick	198 ,,	36 ,,

To bring the mortar in over the main hatchway, rig
stay derrick of the spare fore topmast, and support it by
topping-lift, belly-guys, and a shore to the mainmast.

Purchase.—Blocks, upper fore and main jeer-blocks,
26-inch and 24-inch treble. Fall, fore and main jeers,
8 inch and 7½-inch spliced together.

Topping-lift.—A cat-fall, rove through top-tackle blocks.

Mast-head purchase used for hoisting up, is eased in,
and becomes a stay purchase.

PLANATION OF TABLE VII.—"The first column of figures, d C, contains the mean strength of cohesion on an inch section material; the second, marked S, the constant for transverse ; the third, marked E, the constant for deflections; and the , marked M, the modulus of elasticity.

To find the absolute strength or force of direct cohesion of beams s of given materials, that is, their absolute resistance to longi- l tension or strain in lbs. Rule.—*Multiply the area of the rse section of the rod or beam in inches by the tabular number, column marked* C, *opposite the name of the material, and the t will be the strength or resistance required. Note.* 1.—In e the weight or strain should not exceed $\frac{1}{3}$ of the absolute th according to Barlow, or $\frac{1}{4}$ according to Tredgold. Thus, rce which would tear asunder a piece of teak $4\frac{1}{2}$ inches broad inches thick, is $2 \times 4\frac{1}{2} \times 15000 = 135000$ lbs. Hence a udinal strain of more than 45000 lbs. would be unsafe in ce. *Note* 2.—The tenacity of materials of the same kind is rtional to their specific gravity. Hence, a piece of teak whose ic gravity was $\frac{1}{20}$ part less than that of the preceding, would $\frac{1}{20}$ part less of cohesive power.

. When the direction of the straining force does not coincide the perpendicular to the centre of tenacity or centre of gravity of ansverse section, the Rule is modified as follows: Multiply the ar number in column C by the breadth and the square of the ness of the beam, both in inches, and divide the product by the of the thickness and 6 times the distance of the line of direction the centre of the section, in inches; the quotient will be the lute strength required, of which take $\frac{1}{3}$ as before, for the prac- load. *Note.*—In actual constructions an allowance of $\frac{1}{3}$ of the kness should be made for the probable deviation of the direction he stretching force. The absolute strength will then be $\frac{1}{3}$ of that nd by the Rule in the preceding article; and the practical load $\frac{1}{9}$ the same quantity, or $\frac{1}{12}$ according to Tredgold.

"3. *To find the dimensions of a rod or beam to resist a given longitudinal strain*, that is, to sustain a given weight without fracture in the direction of its fibres. *Rule.—Multiply the tabular number in column* C, *by the number denoting the ratio of the breadth to the thickness, and divide* 9 (*or* 12) *times the given weight in lbs. by the product; the square root of the quotient will be the required thickness in inches, and the thickness multiplied by the number of the ratio will give the breadth required.* Thus, the dimensions of a beam of the strongest English oak to sustain a load of 20 tons in the direction of its fibres, supposing the breadth to be 3 times its thickness is $\sqrt{\frac{1}{3}(9\times44800 \div (3\times15000)}=3$ inches nearly, the thickness required; whence $3\times3=9$ inches, the breadth required. *Note.*—If the beam be cylindrical, divide 9 times the given weight by ·7854 times the tabular number, and the square root of the quotient will be the diameter.

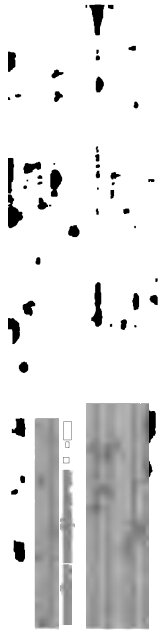
"4. *Force of the Transverse Resistance of Materials.*—This force is proportional to the product of the breadth and the square of the depth in rectangular beams (more properly parallelopipedal beams), and to the cube of the diameter in cylindric beams; but it is in the inverse ratio of the length, modified by the cosine or square of the sectant of the angle of deflection immediately before fracture, and by the manner in which the beam is supported. In ordinary practice, the consideration of the angle of deflection may be omitted.

"5. *To find the relative strength or force of resistance of rectangular beams or rods of given materials, to transverse strain or pressure in lbs.* 1. When the beam is *fixed* at one end and *loaded at the other. Rule.*—Multiply the tabular number, in the column marked S, opposite the name of the given material, by the breadth of the beam in inches, and this product by the square of its depth in inches, and divide the result by the length of the beam in inches, the quotient will be the strength or resistance required. 2. When the beam is *fixed* at the one end and *uniformly loaded*, the strength or resistance will be *double* the preceding resistance, which for brevity we shall call the *prime* resistance. 3. When the beam is *supported* at both ends and *loaded in the middle*, the strength will be *four times* the prime resistance. 4. When the

supported at both ends and *uniformly loaded*, the strength will *times* the prime resistance. 5. When the beam is *fixed* at both d *loaded in the middle*, the strength is *six times* the prime ɔe. 6. When the beam is *fixed* at both ends, and *uniformly* he strength is *twelve times* the prime resistance. 7. When the *supported* at both ends and *loaded at a point not in the middle*, ıgth is found by multiplying the prime resistance by the square ıngth, and dividing the result by the product of the lengths of ıents into which the beam is divided at the point of application ıad.

In all the preceding cases, it must be remembered that not an *one-third* of the ultimate strength found by the rule, ought epended upon for any permanent construction, according to and only *one-fourth* according to Tredgold, who adds that if n be not horizontal, the distance between the supports must orizontal distance. As an example, the weight which a beam . fir, 20 feet long, 12 inches broad, and 12 inches deep, ɔd at both ends, would sustain in the middle, is ($1130 \times 12 \times \div 240 = 32544$ lbs. and the practical load is $32544 \div 3 = 10848$ $32544 \div 4 = 8136$ lbs.

When beams are cylindrical, their resistance to transverse : is only two-thirds of that of a square prism of the same ıs. In the case of a hollow cylinder, the resistance will be ıy multiplying the difference of the cubes of the interior ɔrior diameter, by 8 times the modulus of elasticity and divid- product by 9 times the length. If the hollow part be $\frac{9}{10}$ of ıeter of the cylinder, its strength will be reduced to about $\frac{1}{12}$ an a $\frac{1}{4}$ of that of the solid cylinder; but if the tube were into a solid rod, its strength would be only $\frac{1}{12}$ part of that of l cylinder. A cylinder having half its core hollowed out should ɛred only $\frac{1}{8}$ part weaker, which agrees with an experiment r Barlow. We see here the divine process of nature in making ɛs of animals hollow, and the imitative ingenuity of man in cast-metal pillars tubular, thus combining lightness with in their structures.



will not impair the strength, but it seems up will even sensibly augment it. Thus Duhamel fou willow cut through $\frac{1}{3}$ of its depth, the cut being fille slip of hard wood, was thereby rendered $\frac{1}{6}$ part stron It was even then remarked that the incision could f further without injuring the strength of the bar.*

To find the *breadth and depth of a beam of* wood, to *rest in any, in practice, support a given* of prime resistance (art. 5.) *Rule.*—Multiply the giv by the length in inches, and divide this product by 4 duct of the tabular number in col. S, and the numb ratio of the breadth to the depth; then, the cube root will be the required depth in inches, from which the as before art. 51. In all other cases, the tabular n must be multiplied by the number denoting the incr or resistance arising from the mode of fixing the beam the above rule be applied. Thus, the depth of a bea 18 feet long, to bear a load of 20 tons at the middle, at both ends, the breadth being half of the depth is

$$\sqrt[3]{\left\{216 \times 18 \times (1140 \times \tfrac{1}{2} \times 4)\right\}} = 20{\cdot}4 \text{ inches nearly;}$$ when is 10·2 inches. When the breadth or depth is given,

being proportional to the deflection. Consequently, beams f the same stiffness, when the depth is increased in the same m as the length, the breadth remaining the same; and the n of beams arising from their own weight, having their several ns proportional, will be as the square of either of their like nensions. The same will apply to beams loaded throughout onally to the dimensions: this ought to be kept constantly in the construction of models, on a small scale, of works to be executed on a large one.

To find the Deflection of a Beam: 1. *When supported at both l loaded in the middle.* For brevity's sake, we shall call this e deflection. *Rule.—Multiply the given weight in lbs. by the he length of the beam in inches, and divide this product by the us product of the tabular number, in the column marked* E, *the name of the given material, the breadth, and the cube of the e quotient will be the required deflection in inches.* 2. When n is fixed at one end and loaded at the other, multiply the flection by 32. 3. When it is fixed the same, but uniformly multiply the prime deflection by 12. 4. When it is supported nds and uniformly loaded, take $\frac{5}{8}$ of the prime deflection. 5. is fixed at both ends and loaded in the middle, take $\frac{2}{3}$ of the flection. 6. When it is fixed the same, but uniformly loaded, of the prime deflection. Thus, the prime deflection of a pitch pine, 30 feet long, 6 inches broad, and 10 inches deep, d at both ends, and loaded in the middle with a weight of . is $(1000 \times 27000 \times 1728) \div (5000000 \times 6 \times 1000) = 1\frac{5}{10}$ inches whence the deflection due to other modes of fixing and ng, may easily be found. *Note.*—If the beam be a cylinder, ection will be 1·7 times that of a square beam in similar ances.

To find the weight which will produce a given prime deflection m of given material and dimensions. Rule.—Find the contin- duct of the tabular number in col. E, the breadth, the cube epth, and the given deflection, and divide this product by the

cube of the length; the quotient will be the weight required. Thus, the weight which will produce a deflection of $1\frac{1}{2}$ inch on a wrought iron beam, 20 feet long, 3 inches broad, and 9 inches deep, supported at both ends, and loaded in the middle, is $(91440000 \times 3 \times 729 \times 1\frac{1}{2}) \div (8000 \times 1728) = 21699$ lbs. or near 10 tons; whence, the weight for other deflections may easily be found.

"13. *To find the depth requisite for a beam of given material, length and breadth, to bear a given load with a given prime deflection. Rule.*—Divide the given loads in lbs. by the continuous product of the tabular number in col. E, the breadth and deflection, and multiply the cube root of the quotient by the length; the product is the depth required. Thus the depth of a wrought-iron beam, 20 feet long, 3 inches broad, requisite to support a load of 10 tons with a prime deflection of $1\frac{1}{2}$ inch, is $240 \times \sqrt[3]{\{(10 \times 2240) \div 91440000 \times 3 \times 1\frac{1}{2}\}} = 9{\cdot}1$ inches nearly. When the breadth is not given, multiply the given weight by the cube of the length, and divide this product by the product of the tabular number in col. E, and the given deflection, the quotient is the product of the breadth and cube of the depth. Hence, when the beam is to be square, the fourth root of the quotient is the breadth or depth required: and when it is to be cylindric, multiply the quotient by 1·7, and the fourth root of the product will be the diameter.

"14. *The modulus of elasticity* is the measure of the elastic force of any material. It is found by the following proportion: As the portion of the length of a column of the material, which it loses by compression, is to the whole length before compression, so is the force which produced that compression to the modulus of elasticity. Sir John Leslie has shown that the modulus of elasticity is found by dividing 5 times the fourth power of the length of a beam by 32 times the product of its spontaneous depression and the square of its depth. In his work on *Heat*, he observes that a white deal 138 inches long and $\frac{9}{20}$ of an inch deep, suffered a depression of $2\frac{1}{2}$ inches by its own weight; hence $(5 \times 138 \times 138 \times 138 \times 138) \div (32 \times 45 \times 45 \times 2{\cdot}5) = 11936000$ inches or 9328000 feet, in round numbers. The

in col. M may be found from those in col. E, by multiplying r by 576, and dividing the product by the corresponding gravity.

The resistance of Materials to a crushing force, appears to be proportional to the fourth power of the diameter in cylinders, ıe side in square prisms, and inversely proportional to the f the height.

To find the weight which a column of given material will before flexure.—Multiply the tabular number in col. E by es the fourth power of the diameter in inches in cylindric , or ·2056 times the side in inches, in square prismatic , and divide the product by the square of the length in inches, tient is the weight required in lbs. *Note.*—When the base olumn is rectangular, multiply the tabular number by ·2056 ıe area multiplied by the square of its breadth, and divide e. Only $\frac{1}{3}$ or $\frac{1}{4}$ of this weight ought to be depended upon ice; for when once the column begins to bend, the conse- are inevitable. Thus, the weight under which a pillar of ıgland fir would begin to bend, supposing its length 20 feet, diameter 12 inches, is (5967000 × ·121 × 12 × 12 × 12 × 12)÷ × 12 × 12) = 259922·52 lbs., or nearly 116 tons, a most enormous cording to theory; but 29 tons could only be trusted in practice.

e *Resistance of Materials to the force of Torsion, or Twisting*, is proportional to the angle of torsion and the fourth power of neter in cylindric shafts, and inversely as their length, accord- ir John Leslie: other writers say, that it is directly proportional ubes of the diameters. According to the Professor's law, the of an iron cylinder to resist the torsion of a weight in lbs. t a distance of a foot, is found by dividing 600 times the fourth of the diameter by the length. The preceding principle is ed in the construction of the *Balance of Torsion*, invented by b."

535. FOREIGN MEASURES.—As six metres are equal to 19½ feet, there is just water enough for you; and, at high water, as "the rise and fall is about a metre," there would be upwards of three feet to spare.

In the new French charts, the soundings are in *mètres;* but in their old charts, in *brasses.*

536. ASCERTAINING LOCAL DEVIATION OF THE COMPASS.—Lay a kedge out, and swing the ship with *her head* to each point of the compass, observing, as each point comes on, the bearing of some object whose distance—not less than six or eight miles—is such that its angular distance, between the limits of the ship's position while swinging, will not be perceptible. Note down these bearings, then land with a compass, and ascertain the bearing of the object on shore, when the ship and the distant object are in one. The difference between that and the various bearings taken on board, will give the local deviation for each point of the compass;—east, when the ship's bearings are to the left of the true magnetic bearings; and west, when the contrary is the case.

Example.—Oct. 1, 1856. Second Bar Pagoda, distant 13 miles, bore from H.M.S. ——, at anchor off Chuenpee, N. 32° 20′ W. with the ship's head south; and N. 23° 5′ W. with her head N.W. From Anunghoy, with the ship and object in one, the Pagoda bore N. 29° W. Consequently the deviation of the south point of the compass was 3° 20′ E.; and of the N.W. point, 5° 55′ W.

In a close harbour, where there is no object sufficiently note for the purpose, it will be necessary to erect a mark shore, and to land an assistant with a compass to take iprocal bearings. When ready, you hoist a preconcerted nal, which you dip as the ship is swung on each point the compass to the mark ashore. The difference beeen the bearing of the mark from the ship, and the bear- of the ship from the mark, reversed, is the deviation of e compass on board, corresponding to the direction of e ship's head at the time of each observation. If there any actual difference between the compasses employed, e correction must be made. To ascertain it, land the mpasses, and compare the bearings of an object taken ith each; but the compasses should not be within twelve et of each other.

When unable to land, take the bearings of a distant obct, with the ship's head round the compass. Assume the ue magnetic bearing to be the mean of these; and by omparison ascertain the deviation on each point accordngly.

As the deviation in the northern hemisphere is changed n the southern hemisphere, it will be frequently necessary at sea, if the deviation is great, to determine it afresh as you alter your latitude. You should, therefore, take advantage of light winds, or calm weather, to ascertain the variation of the compass by azimuth observations, with the ship's head in different directions, computing the deviation on the points you have not observed, from those that have been; the rule for which will be found in Inman, art. 308.

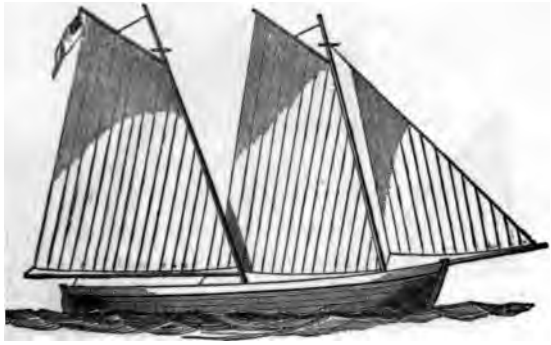
537. POSITIONS AND DIMENSIONS OF MAS YARDS.—All the information here given is derive Fincham's "Treatise on Masting Ships," to wh reader is referred for a complete investigation of ject in all its bearings.

"The common rule for determining the masts a by the length and breadth of the vessel, has been by long use, and may be considered equally g any of the rules at present given as approximat the yards must be governed by the length, in c the sails may have a suitable spread; and the which determines the length of the masts, that have proper support by the spread of the riggin greatest influence on the stability."

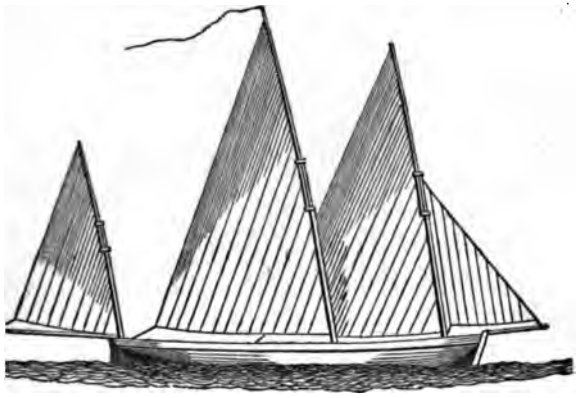
In accordance with this principle, Tables IX. t formed; and though much curtailed, they are su solve the proposed questions, and to meet any case that may occur on service.

The following sketches are also from Fincham.

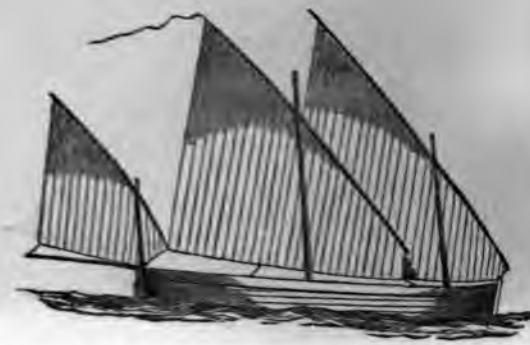
RMUDA SCHOONER,



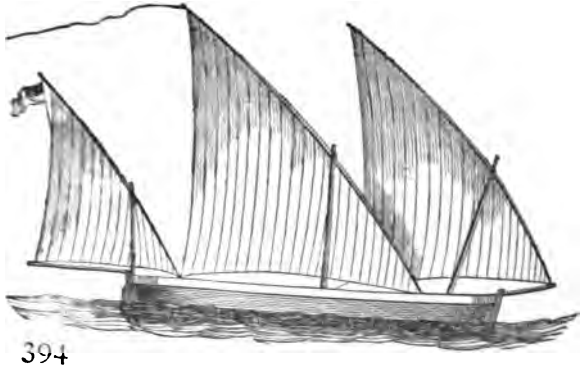
.IDING GUNTER.



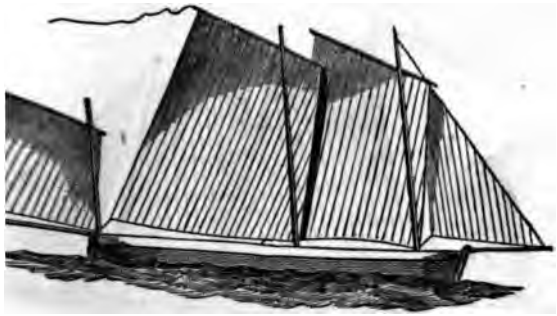
3. SETTEE.



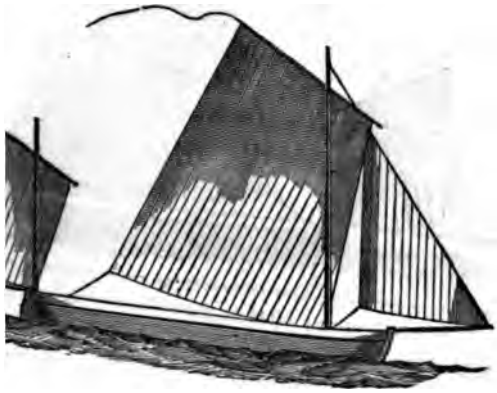
4. LATEEN.



IREE STANDING LUGS,

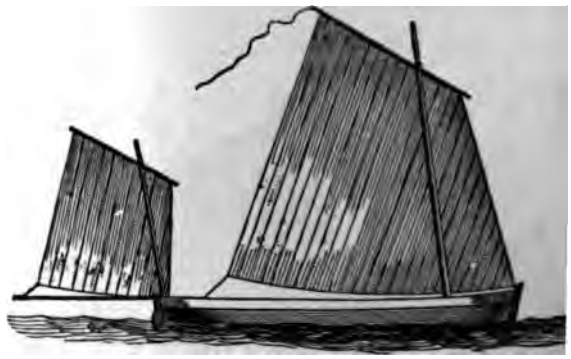


ER WITH A STANDING LUG.



7. THREE SPRITS AND A JIB.

8. CUTTER WITH A DIPPING LUG.*



* A cutter's mizen, fitted in the ordinary manner, is not a h sail. On shoving off from a ship, it is often a troublesome mat get the boomkin clamped; the tiller gets jambed, the con

538. HEAVING DOWN.—The following account of the aving down of H.M.S. "Formidable," 84 guns, from e "Nautical Magazine," contains an explanation of the bject.

The "Formidable" arrived in Malta harbour on the th of January, 1843, and received orders to prepare for aving down; the ship was accordingly moored head d stern, with her bower chains and anchors, off the ening wharf, and cleared of everything. Not a pig of ast, or a moveable article was left in her, with the ex- tion of the coppers, range, and main-deck tank, which re all well shored from the ship's side, and otherwise cured. As the ship was to be hove down on the star- ard side first, the hammock-nettings on that side were moved, and the partners of fore and mainmasts on upper d main decks were taken up.

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wildered, and a great deal of confusion is occasioned in conse- ence. Should you want to keep away suddenly, it is of no avail to t go the sheet, for, except in a stormy breeze, it will not overhaul. o remedy this, cut the boomkin off to within a couple of feet of the ern, stepping, and clamping it as hitherto. Provide a boom of the me spread as the original boomkin, seize the tack of the sail to the ter end, fit a swivel-bolt to the foremost end, and forelock it to a nd round the mast. Splice a topping-lift from the mizen mast- nd round the outer end, seize a sheet-block to the boom amidships, nother to travel along the boomkin, and reeve the sheet with the nding part alongside the block on the boom. On getting the asts down, top the boom up, unclamp the boomkin, and (without nreeving the sheet, which is passed round all as a gasket) make the oom and boomkin up with the mast and sail.

Bulkheads.—The bulkheads were three in number were placed on the main deck—one at each end c starboard skids, and the third was built across und break of the poop. They were constructed in the f ing manner. Strong frames were nailed to the l overhead, and deck; into these were morticed strong round uprights, and against the flat sides of these placed the planks which went athwartships. The men commenced boarding from top to bottom, which the sheer of upper deck, left the space to be filled the last, or midship plank, in the form of a wedg this means, when the board was driven in, the thing was wedged up taut. The bulkheads were ca and payed, then shored up behind from the beams from cleats nailed to the deck. All the bulkhead tended from the ship's side to amidships.

Ports.—The lower-deck ports were barred in caulked; the scuttles in them well secured, and bo over outside, then payed with pitch. The main ports, with the exception of the four midship ones, be the bulkheads, which were left open, were boarded in two-inch plank, then caulked, and shored up from i to cleats on the deck.

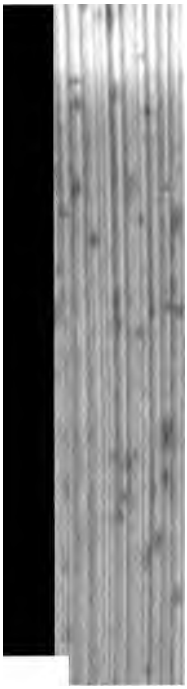
Shrouds.—Nine to mainmast—five on lower and four on the main deck; seven to foremast—fou lower deck, and three on main deck. Those on l deck were square balks of timber, 2 feet in the squar feet 6 inches long, and were placed in ports as near ab of the respective masts as possible; then secured by l

chocked in the ports, the heels butting against comb-, bitts, &c. Where there were none, they had a heel-e from starboard waterway, and were also secured a fetching way or rising, by being well shored in every ction. The main deck outriggers, about 18 inches in square, and 35 feet long, were placed and secured in ame manner as those on lower deck. All the out-ers were rounded, shouldered, and cleated for rigging utt against, at about 18 inches from the outer end.

Outrigger Martingales—were 8-inch rope, fitted with a e thimble at each end, middled and taken with a round a over the end of the spar, then seized. Those of n deck were pulled up to short chocks in lower-deck ts; those of lower deck, to span shackles driven ugh ship's side, and forelocked inboard. Starboard ttles, scuppers, and chain-pump pipe were all plugged and boarded over outside; the pigeon-holes only, ween main-deck bulk-heads, were filled in and caulked, ng the only place where water was allowed to come.

Bilge-pumps.—Of these there were five—two in fore chway, two in main, and one in after hatchway. They e stepped in the lower-deck ports for wells, and the er deck was scuttled abreast the hatchways, close in starboard waterway, to allow the water to pass up from op deck to pumps. Temporary stages were erected in square of the hatchways, for pumping party to stand while working.

Masts—Were stripped of everything but lower rigging; tops and cross-trees being removed, and fished on fore



wounded in nine places, nine turns i
rope), and well wedged up. Th
perfectly upright, but both main st
side of the foremast, to allow the m
on port side. The upright shores of
in number; the first and largest was
and went up within 6 inches of the
being chamfered out to allow it to
the second was placed a third lower
between the head of the second and
all secured to the mast by a head-l
horizontal shores between them and
oak plank, about 2½ inches thick,
belly-lashings were passed, and prove
to the mast. Of these horizontal sho
there were three on the long shore,
the others. All the heels of the up
a thick elm plank laid along the
being well shored underneath.

Preventer Rigging—For mainmas
shrouds and one pendant, 12 inch ro

the purchase block; then remainder of the shrouds; tly, the pendant with a lashing-eye. The rigging was ded up by double 20-inch blocks, double stropped, the t of the shroud taken through the strop, and toggled. e lower block strop went over the head of the outrigger; d the falls were of 7-inch rope. The foremast was ured precisely the same as the mainmast, excepting t it had but one fish, and that on the after side; seven ouds of 13-inch rope; two upright, and three horizontal ores, and belly-lashings; and both fore and mainmasts d, when secured, runners and tackles steadied forward assist the stays. The heels of fore and mainmasts were ll shored in the hold on port side. The mizen mast was pped of everything, the same as the other masts, cepting that the cross-trees were left on; and the only pport given to this mast, beyond its own rigging, con-ted of the sail-tackles from mast-head pendants, hooked to e weather chains, which took some strain off the rigging.

Setting up Rigging.—The masts were steadied over ainst the port lower-deck partners, the wedges having en removed; the starboard rigging was then pulled up r a full due, the preventer rigging pulled up with luffs on eir own falls, and secured to the toggles. The standing rt of the fall went with a running eye over the end of the utrigger, and the preventer rigging was pulled up last.

Mast-head Purchase Blocks.—Main purchase block, 40 nches; main small ditto, 30 inches; fore ditto, 40 inches; ll treble sheaved, and treble stropped. The 40-inch locks were, in the first place, double stropped with 9-inch

cable-laid rope, with a long eye to take the turns lashing: and they had also a preventer strop of 9-inc long enough to go round the mast-heads, where the secured with two lashing-eyes. The 30-inch blo double stropped with 8-inch, and with a 9-inch pr fitted as above. The purchase blocks were lashed a mast-head after the first two pair of shrouds were p and at the fore, after the first pair of shrouds. A were two main purchases, the largest was lashed o most quarter of mast-head, and the smaller one after quarter, but no shrouds were between them lashings were selvagees, 500 new yarns, 30 fathom those for preventer strop were the same size, but long, and had been used before. In lashing the the fore and main runners were used in the fo manner:—Supposing the main to be the block lashed, the fore runner pendant block was lashed mast head, and the runner taken to mainmast hea tackle was hooked up and down to the foremast, a a tricing-line on upper block from the mast-head, t haul the runner after it had been pulled up; the s was middled, and seized to the strop in the eye; o was passed round the mast-head, through the eye strop, then racked to the runner pendant, which was up on deck. When taut enough, and the turn of th ing had been racked, the runner was overhauled girtlines and tricing-lines as before mentioned.

Pit Purchase Blocks—were double 40-inch, stropped with 9-inch rope; the leading blocks 3

[illegible] stropped. The double blocks were stropped on the [illegible] in the pits; the leading blocks had strops long enough [illegible] round one bar, and lash to the other, there being two [illegible] pit.

[illegible].—Three in number, of the same sort as those [illegible] at sheers: 20 bars each, six men on each bar.

Tripping Cables—were two in number, one forward and [illegible] aft. A hemp cable, having been chafed when heaving [illegible] ship off at Barcelona, was condemned and cut in two, [illegible] used for this purpose. Two purchases of new 9-inch [illegible]ers, through treble 40-inch blocks, were rove. For [illegible] after cable, one block was lashed ashore round the [illegible]es at the buildings, on the opposite side of the creek, [illegible]st the careening wharf (creek about 60 fathoms wide), [illegible] the other block was clinched to the end of sheet cable, [illegible] then hung to a lump to keep it off the bottom. The [illegible]er end of that cable was taken under the ship's bottom, [illegible] brought up on the starboard side through a starboard [illegible]per-deck port, before the after hatchway, then across the [illegible]ck, and clinched through two ports on the port side. [illegible]e fore tripping-cable was fitted the same as the after, [illegible]t came through third port on the forecastle, starboard [illegible]de, and made fast as before mentioned. From its leading [illegible]er the fore chains, they were well shored up, but were [illegible]st down from the immense strain on them when the [illegible]p was half-way down.

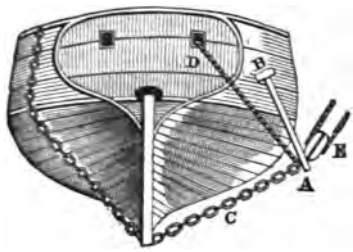
Righting Cables—were fitted the same as the above, but [illegible]aller, the stream cable being used instead of sheet. The shore blocks were lashed to bars in the pits, the cables

went under the bottom, and were clinched through port main-deck ports. These were precautio measures, no strain being ever brought upon them.

Reeving-lines and Falls.—Reeving-lines were new 7- rope, about 150 fathoms long. Falls; fore and 10½-inch, quite new, hawser-laid rope; fall fo second main purchase, new 9-inch hawser-laid rope. 10½-inch was reduced to 9½ inches when unrove. falls were 140 fathoms long, and then rather short.

When hove down the first time, they found the buttocks hove her stern so high out as to be inconv to the workmen; therefore, before she came dow second time, thirty butts were lashed under the fore c which had the desired effect of keeping her keel pa She was kept quite free by one of Hearle's engines.

In the third vol. of the "Nautical Magazine" th an account of an accident which happened to H "Success," Captain W. Jervoise, by running on a re rocks at the entrance of Cockburn Sound, in 182 which is appended a description of the means empl for heaving her keel out for repair, by means of outri from the side.



A is the after rigger, stepped in a s B, which is bolted to ship's side, abaft main chains.

The foremost out

anted abaft the
as.
e after girder,
nboard the port
ught under the
attached to the
e outrigger.
: after guy, the
guy being led
gh the gangway

after purchase

foremost cap-
taken out of
cess,' and fitted
re hatchway of
sty's cruiser," by
ssel the "Suc-
s hove out.

) R C H A R D'S
OF SLINGING
VESSELS.—
shows the posi-
he sweeps, and
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veeps are rove,
ne chain is

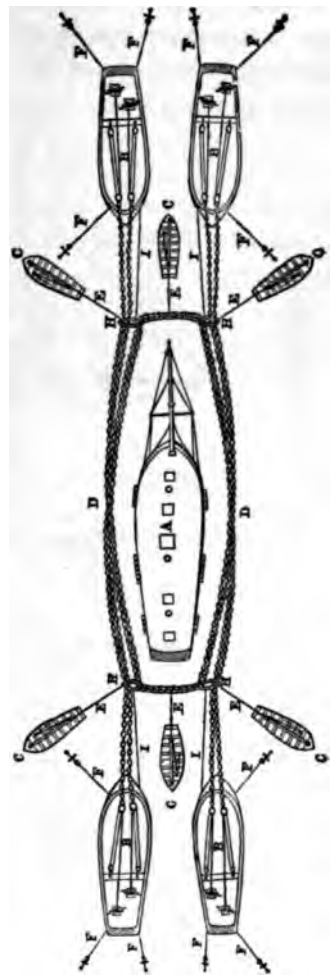


Fig. 2 shows the wreck slung and weighed.

n board each weighing vessel. A. The wreck.
ing vessels. C. Launches, for suspending the
the proper height. D. Sweeps. E. Suspending
Cables and anchors. H. Jewel rings. I. Jewel

O CALCULATE A VESSEL'S TONNAGE.—The old measurement is that still employed in the navy, ıse only in giving an idea of the relative size of of *each class;* for as length and breadth alone the calculation, a razee still retains her original ɔnnage, whatever be the reduction in size conse- the alteration.

ngth for tonnage, the breadth, and half the nultiplied together, and divided by ninety-four, tonnage by what is termed old measurement. gth between perpendiculars," is that at the middle hree-deckers, and at the upper deck of all other n fore part of stem, to after part of stern-post, ı corrected for the rake of stem and stern-post, l "length of keel for tonnage." The "breadth ge," is the extreme beam of the ship (from outside e), with a trifling deduction for the thickness of in excess of that of the bottom planking.

new measurement, a far more accurate estimate is of a ship's internal capacity; as length, breadth, ı are all employed.

ngth of the upper deck is divided into six parts, d the depth taken at the foremost, aftermost,

and midship points of division. These three perpe
measurements are each intersected at four inte
points, b, c'' which divides them into five equal par

The length for tonnage, $f g$, is the
of the ship from after side of stem
side of stern-post, at a height half-
the midship line of section a'.

The depths to be employed are, tw
depth of the midship line of section
added to once the depth of the forem
aftermost sections, at a and a''.

The breadths used are, at the fo
section a, the (internal) breadth of t
at b, added to the breadth at c.
midship section a', three times the l
at c' are added to once the breadth
In the after section a'', once the bre
b'' is added to twice the breadth at c

Then, the product of the sum
depths, into the sum of the breadths, i
length for tonnage, divided by 3500,
the number of tons for register.

If the vessel has a poop; multiply t
the inside length, breadth, and height,
the product by 92·4, and the quotient
the number of tons to be added.

To find the real capacity of a vessel, multiply the r
tonnage by 92·4, for the contents in cubic feet.

Example.

		Feet.
at half midship depth	159·4	
at foremost division	29·66	29·66
midship ,, ...	30·66 × 2 =	61·32
aftermost ,, ...	29·08	29·08
Sum of depths.....		120·06
Foremost division :—		
th at one-fifth of the depth	37·74	37·74
four-fifths of the depth.....	31·00	31·00
Midship division :—		
th at two-fifths of the depth	40·00 × 3 =	120·00
four-fifths ,, ...	36·08	36·08
fterмost division :—		
lth at one-fifth of the depth.....	34·58	34·58
,, four-fifths ,, ...	17·50 × 2 =	35·00
Sum of the breadth.....		294·40

$$\text{t, } \frac{120\cdot06 \times 294\cdot4 \times 159.4}{3,500} = 1,609$$

$$\frac{39 \times 30 \times 6\cdot5}{92\cdot4} = 82$$

1,609

	Feet.
Mean length of poop	39·0
,, breadth ,,	30·0
,, height ,,	6·5

Total register 1,691 tons. 1,691 × 92·4 = 156,248 cubic feet.

141. STOWING BOOMS.—I know of no better plan than following, for it possesses the great advantage of allowany one spar to be taken out without disturbing the t. A and B are iron crutches. A is one of the foreıst ones, in which the sterns of the barge and pinnace it; and B B are the after ones, sufficiently far forward to ow play to the mizen topmast and hand-mast, when they

require to be removed. The bows of the barge and pinnace rest on crutches similar to A, but without the cross-piece.

PORT BOOMS. STARBOARD BOOMS.

Port Side.	*Starboard Side.*
I. Fishes.	I. Hand-mast.
II. Hand-mast.	II. Mizen topmast.
III. Fore topmast.	III. Main topmast.
IV. Fore top-gallant mast.	IV. Main top-gallant mast.
V. Jib-boom.	V. Jib-boom.
VI. Fore topsail yard.	VI. Main topsail yard.

The mizen top-gallant mast is stowed on the top of the fishes; the spare fore top-gallant yard alongside the jib-boom on the port side; a top-mast studding-sail boom on each side; and a couple of small spars, stowed where convenient, between the larger ones, comprise the whole of the booms. In the starboard main chains lies the spare main top-gallant yard, and in the port chains, the mizen topsail yard.

Iron-clad ships are not often supplied with more than one spare jib-boom, topmast, or topsail yard; small spars for boats' mast, &c., can be stowed in the hammock nettings.

542. FIRE ON SHORE.—The following disposal of a [redacted]re brigade for landing," was drawn up for a corvette.

On the boats being called away for the above purpose, [redacted] pinnace-men will drop their boat under the main yard, [redacted]dy to receive the engine and field-piece limber carriage; [redacted]d the midshipman of the boat will see all the wash-deck [redacted]kets passed into her by the boat's crew, and will be [redacted]ponsible for their not being lost ashore.

The gunner and his crew will provide a 100-lb. barrel of [redacted]der (previously bored and plugged), two port-fires, or a [redacted]om or two of Bickford's fuze in preference, if there [redacted]any, and a slow-match; pass them into second cutter; [redacted]d, on landing, be in readiness to blow up any building [redacted]t it may be necessary to level, to arrest the progress of [redacted]e fire.

The boatswain, with forecastle-men and riggers not be-[redacted]nging to boats, provide fire-grapnel, and two hook-ropes; [redacted]s them into the second cutter, and, on landing, take [redacted]arge of them.

The carpenter and his crew, having passed the engine [redacted]r into the pinnace, will provide a couple of axes, and [redacted]p down into the boat.

The sergeant will tell off twelve men into the pinnace, [redacted]der a corporal to work the engine; and fall in a corpo-[redacted]al and eight men on the quarter-deck, in readiness, to [redacted]ceive ball cartridge, and then land in charge of them in [redacted]e first cutter.

The lieutenant in charge will take the second gig, and be [redacted]ccompanied by the assistant-surgeon with provision for

accidents. and with the bugler to sound the assem
calling the men together at any particular spot.

All the party are to shift in their old blue clothes,
rig in caps, shoes and stockings. On landing, the
man the drag-ropes, and, with all speed transport the
and gear to the scene of action.

Mr. ———, will remain in charge of the boat
boat-keepers.

If the fire is not very alarming, the right thing to d
probably be seen at a glance; but, should it already
spread to any great extent, or have caught, by the
sparks, &c., at more points than one, with many inte
ing buildings, the exertions of your party cannot be
ently directed unless you have been able to take a s
of the fire from the top of a house which commar
view of the whole. From such a position, you ca
where a stand must be made to check its progress;
having formed your plan, let nothing divert you fro
accomplishment No time should be lost in passing
furniture, and in tearing down windows, jalousies, d
and wooden erections of all kinds; for, by trying to
too much, you risk the loss of all. If you have any sca
ladders, they will be found of the greatest use; and
range of the engine may be considerably increased
placing your thumb on the nozzle occasionally, that, o
withdrawal, the water may escape with greater force.

Wherever there are no organized fire companies, ind
sion is always painfully apparent. A plan is no sooner

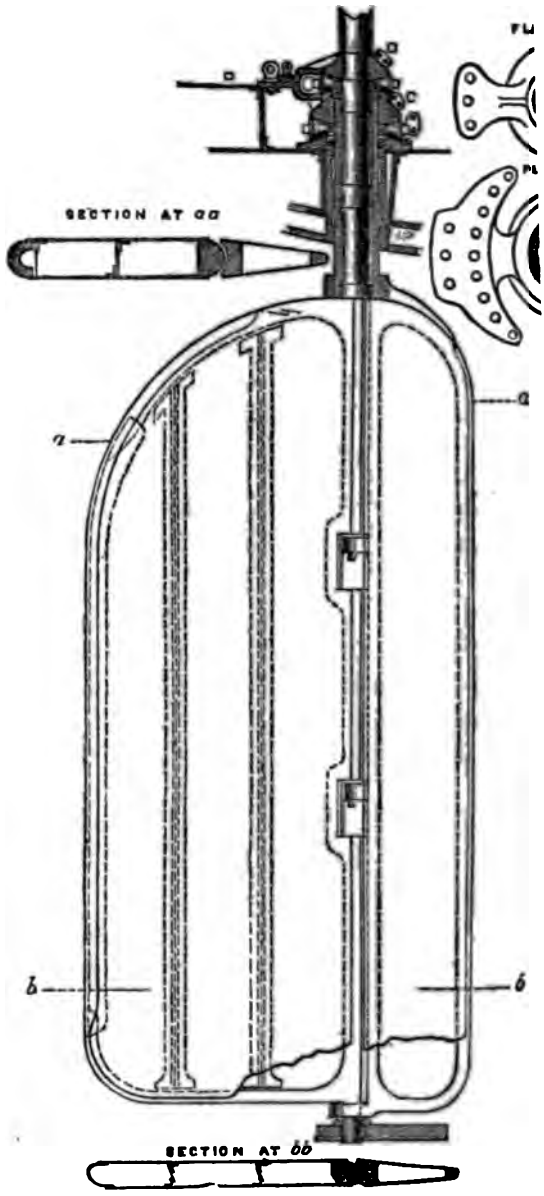
a that it is abandoned for another which appears more ible; while the fire, in disadvantageous contrast, steadily nes its undeviating course. Wherever, therefore, the ices of his men are needed, the naval officer should mptly assume the direction of affairs.

143. RUDDERS ARE HUNG—By pintles and gudgeons; the tles slip into the gudgeons, which are fixed to the stern-t, and are prevented from unshipping by wood-locks.

144. BALANCED RUDDERS.—Owing to the increased e of ships, and the corresponding increase in the dimen-ns of rudders, immense power is required to efficiently ntrol the helm.

To obviate this the balance rudder has been introduced o several of our new ships, and has, on the whole, been ended with marked success; this rudder instead of nging to the stern-post by pintles and gudgeons, steps an extension of the keel and pivots at about one-third its length from forward; its advantage consists in the ssure of water on the fore part, partially counteracting e pressure of water on the after part, particularly when ch helm is given.

Although this form of rudder gives the most satisfactory sults in ships under steam; still, when under sail only, has been found to retard the ship's way, and act too ddenly in stays; to meet this, an ingenious improve-ent has been tried, as shewn in the figure, by which the dvantages of a balance rudder are derived when steaming,


SECTION AT aa
a
a
b
b
SECTION AT bb

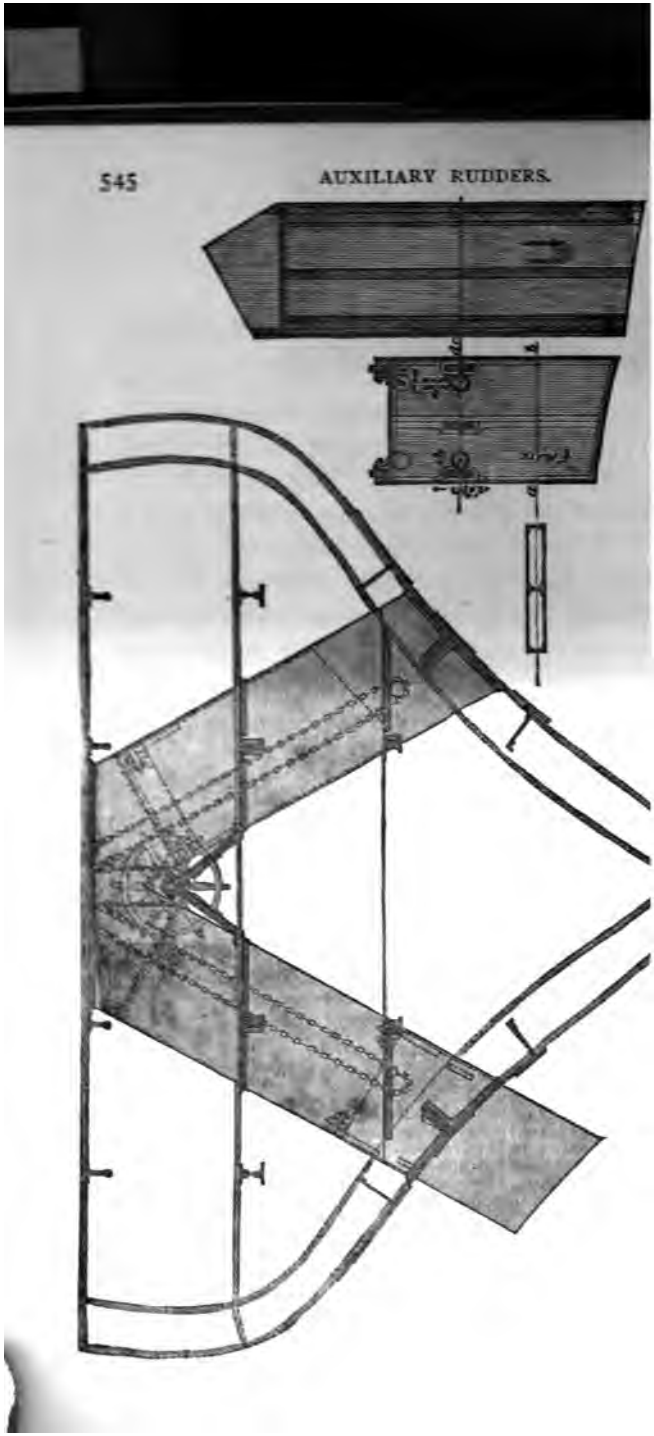
e by simply locking the fore part; it can if necessary, uickly converted into an ordinary rudder.

XILIARY RUDDERS.—Much attention has of late been ed to the want of auxiliary steering power to be used he event of a ship's rudder being disabled. An pt to meet this difficulty has been made in H.M.S. ; in this vessel an iron trunk has been built on each ter before the screw; a rudder is enclosed in each nk, connected by a chain taken round a steering wheel ed between the trunks; when not in use the lower ges of the rudders are flush with the counter, from the companying plate* it will be seen that the effect of turning e wheel, correspondingly raises or lowers the rudders.

545. ACTION OF RUDDER.—The great thing to remember this, that when a ship is answering her helm it is the ern being thrown round by the pressure of water on the dder which alters her course, and that it is the head hich is governed by the stern, and not the stern by the ead; so much is this the case in screw ships able to ive a large angle of helm, that if the helm be first put ard over and the engines started ahead, the ship will rn two or three points before gathering way.

As a general rule it may be stated that screw ships turn on a point one-third before their centre, therefore in avoiding collision when nearing the danger, steer so that your bow may go clear; having done this, as the point on which your ship pivots passes, reverse the helm, and by

* See next page.



ing, endeavour to throw your stern clear. The more n given, the smaller will be the diameter of the circle e; the more speed used with the same helm, the ker will you turn though describing a larger circle.

546. WEATHER HELM.—The centre of effort of the sails generally abaft the centre of the vessel, the ship is sed more against the water, on the lee side; the heel ie ship immerses the lee bow, which tends to throw the up in the wind.

hat the amount of weather helm carried increases as wind freshens and the ship heels more, is partly at- table to the oblique angle given to the rudder, causing lose much of its effect; the best practical proof may found in boat sailing; in a steady breeze a boat can so trimmed that she will carry a very small weather l, but let the wind become squally, and as she heels ach puff, the small weather helm will be doubled. ther helm may be diminished by reducing or bracing the after sails, or by relieving her of any sail that r be pressing the bow, and by trimming more by the n; but long screw ships will always be found to carry ch weather helm when under sail alone.

547. SHIFTING A RUDDER.—In the upper deck, over e rudder-head, are a couple of holes for the reception of e eye-bolts to which the tackles are suspended, which, ien the plugs are driven out, are forelocked above the ck. Hook to them the upper blocks of two up-and- wns, unreeve the falls, pay them down through the

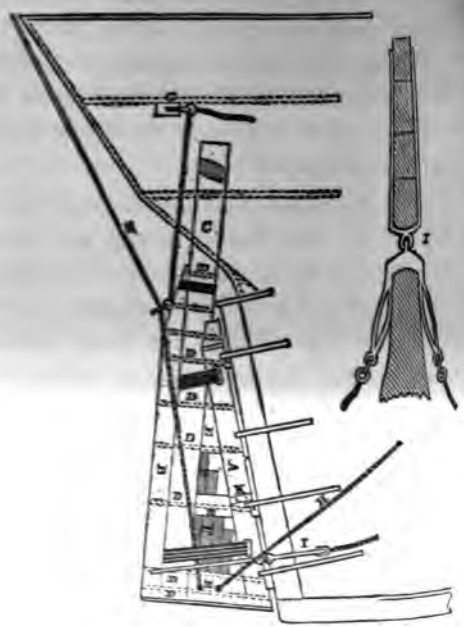
rudder-well, and reeve them through the lowe
outside the ship; when rove full, lead them along
Shore the deck up if necessary, and run guns fo
bring her stern sufficiently out of the water to en
to get at the wood-lock, which you unship. Driv
bolt into the rudder, on each side, to hook the t
sufficiently low down to allow the rudder to be u
without bringing the blocks up against the stern.
spanker-boom well up, hook a burton from the n
to the boom-end, at which point attach anothe
overhauled down to the water. Haul up a c
boom-boats under the stern, with their stems forw
them together with a spar across the bows, and
over the after thwarts, leaving sufficient space
rudder to hang between them. Unshackle the
chains, man the tackles, and unship the rudder.
end of a hawser from the boats, between the ru
sternpost, and drop it down within a few feet of
knot the parts together, and hook the burton to
walk back the tackles, and pull up on the bur
clears the rudder-hole. As soon as the head is c
the other end of the hawser round it, walk back,
it to the spar across the bows of the boats; pul
burton, and hang the lower part of the rudder to
across the sterns of the boats; unhook the tackles,
the boats ashore.

The new rudder is shipped by the same means
that the burton is dispensed with, and a heel-rope
midship lower-deck ports on each side is empl

e the ruddder to. These are fitted with long eyes, are each passed through a hole in the heel of the er before it is launched; a toggle is slipped through eyes, and lanyards from them are led up to the bolt the rudder-chains, so that, when the rudder is shipped, guys can be disengaged.

With the spanker-boom, and a runner and tackle, you shift a rudder as follows:—Runner rove through a k on spanker-boom, cleated to prevent its slipping for- d, down through a hole in the upper deck, and hitched ugh the tiller-hole. Tackle led along upper deck. nker-boom shored up; and heel of rudder lifted by ton from spanker-boom end to a lashing round rudder ater-line.

548. TEMPORARY RUDDER—in accordance with Admi- ty Order of 4th January, 1840.



A. A piece of fir, sided one-third less than the stern-post; fitted with iron pintle
[illegible] in dock, and supplied to each ship.
B. A piece for the back, either provided, or taken from the ship's stores; side
[illegible] of post at the heel.
C. Screw-tompion, and oil clear of the sheeve-hole.
D. [illegible]
E. [illegible]
F. [illegible] ballast.
G. Screw-eyes [illegible] quarter-deck beam, to be put in when required.
H. Rudder-gudgeons [illegible] the rudder-back B, to facilitate the hanging of the rudder.
I. Gudgeon-straps, fitted to the stern-post while in dock, and supplied to the ship
K. Lower pintle, to be a inch or so longer than the others.

---

*The guys attached to the gudgeon, I, should be led in through th
hawse-holes, hove taut, and secured.

549. FALSE KEEL.—In the event of a ship getting ashore, the false keel will come away and free her, when more than an ordinary strain is brought upon it, and the main keel thereby remains uninjured.

550. PRECAUTIONS AGAINST FIRE-RAFTS.—The following were adopted in the Canton river, 1856-7 :—

Ships off the Factories, moored head and stern, were protected by a boom thrown across the river, above and below the position. The largest boom, above the Factories, was formed of two layers of large spars, lashed together, with a stream chain laid between them, bolted to the spars on alternate sides, and the whole woulded round at intervals.

The spars were not placed so as to lock in throughout, but a small space was left every forty feet or so, to impart flexibility to the boom. At *c c* were two loaded sunken junks. At *b b* two junks moored head and stern, with long 32's mounted forward, and guns' crews on board. At *a a*, two junks, to which was attached a small boom to screen the entrance.

The ships were fortified with a spar from each bow, meeting, and lashed together at the outer ends, and drooped by a tackle from the jib-boom end. Flying-boom kept in. From these outriggers, spars were continued aft to the gangways, supported by tackles from the lower yard-arms and boomed out by spars from the ship's side, which afforded space and shelter for the boats to lie within.

From the jib-boom end was suspended a fire grapnel, or a small anchor, shackled by a length of small chain to the riding-cable, outside the hawse. This was intended to drop into the fire-vessel, and anchor her by, on the cable being slipped and the ship dropping clear.

Over the stern, an anchor was hung, which, in the event of a fire-vessel becoming fixed to the bows, would, on being let go, and the lower cable slipped, bring the ship up by the stern, and throw the junk off.

As wooden tanks, containing upwards of a ton of powder floating at the water's edge, were occasionally sent down, the fire-booms were kept eased down, and floated on the water, and a guard boat anchored ahead.

To prevent attacks from torpedo boats, guard should be rowed round the ship at night, and one boat anchored some distance ahead of the ship, both having orders to seize any suspected boats by the stern.

551. Destruction of Booms.—Blow the boom up with a breaker of powder; rouse up the bight of the chain; load with shot a launch's gun; lash the chain across the muzzle; fire, and take advantage of the result. You may

racture a chain in the same manner with a blank
ge.

. MOORING HEAD AND STERN.—The appliances for
ıg stern cables are usually very insufficient. Some
are unprovided with either bollards or ring-bolts.
this is the case, having passed the cable out through
ɔw hawse-hole, and brought it round outside, reeve it
rough one stern hawse-pipe, out through the other,
hackle it to its one part, outside, with a slip-stopper.

t go headmost anchor, veer away, let go stern anchor
the bows, heave in forward, and veer away stern
: to the slip,

3. REPLACING COPPER UNDER WATER.—With refer-
to this subject, the following copy of a letter has been
:d by the Lords Commissioners of the Admiralty.

"BERMUDA YARD, *March* 20, 1844.

SIR,—In obedience to your directions to report the
ner in which I proceeded to replace a defective sheet
opper on the bow of H.M.S. 'Hyacinth,' the same
ıg five feet below the light water-line, I beg leave to
:, that on considering what means could be adopted
ɔo doing, short of heaving the vessel out, it occurred to
that the principle of the coffer-dam might be applied
t. I accordingly caused a water-tight case, of three
:s and a bottom, to be made; ascertained the curve of
bow on each side of the defective part, and cut the

mouth, or open side of the case, to fit it; and, ha
lined, or dressed the curved edges with felt, saturated
tallow, and attached ballast to the bottom, the case
suspended by a tackle to the rough tree rail, and lowe
until the top was within a few inches of the surfa
opposite the defective part, over which it was hauled
means of two hawsers: one passed vertically, from
rough tree rail, under the keel, to the opposite side; t
other horizontally, from the quarter, round the stern,
the opposite side, where both were set taut with tackles.
these means the case was made to fit close to the botto
where it was further secured by a shore, reaching from t
side of the ship to its outer edge, to prevent its risin
The suction-hose of a fire-engine was then placed in t
case, and the water contained in it pumped out; whe
empty, the shipwright descended, and removed th
defective copper, replacing it with a new sheet. Th
operation, from the time of suspending the case unt
completed, did not occupy more than twenty minutes.

"If I might be allowed to offer an opinion, I shoul
say that this principle could be applied to the repairs
many defects under water, such as the wing cocks of ship
or the pipes in the bottom of steam-vessels; and litt
difficulty could be experienced in this, as every vessel i
Her Majesty's service has the means within itself o
applying the principle.

"I have the honour to be, &c.

"W. MOODY,

"*Foreman of Shipwrights.*"

If you have not the requisite drawings on board, the e of the ship's bottom outside may be approximated a mould taken from the inside, on either side, and w the injury, up to a short distance above the water- ; and, unless the case, when hove to, fits very tight, it be necessary to chinse it in between its edge and the 's bottom, as you pump out."

554. LIFTING A SHIP'S STERN OVER THE SILL OF A CK—with tanks. Rig a stage of large spars astern, h the foremost end down to the ship at low water, and p the after end down, and secure it, by shores from the m and quarter.

Sling the stage by tackles, so that at low water the sur- e may be a few inches below the tops of the tanks, en floated underneath.

To float them under, partially fill them; then rouse m under, and secure them: as fast as they are placed, mp them out, and watch for the rise of tide.

555. BOATS IN TOW.—Dismount the gun, and place it the bottom of the boat amidships; shift the shot-boxes , and haul the boat *close up* under the stern—the closer e better. Tow with a hawser from each quarter, to keep r steady, and as a precaution in case one carries away. eeve one through the shackle in the stem, take a turn und the standing thwart, and let a hand hold on to it, ady to slip in a moment; take the other also round the wart, frapping it in slackly to the stem, (for if out on the w, the boat would steer wildly), and let it be similarly

attended. Caution the coxswain to be particularly careful about the steerage; call all out of the boat but these three hands, and see the hawsers parcelled in the nips.

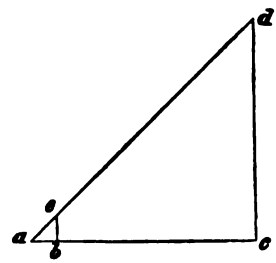
Watch the boat yourself from the steamer, not leaving her for a moment, and acquaint the officer of the watch should the swell of the water rise up to the gunwale, that the steamer's speed may be slackened. If you see the water come over, do not wait till she buries herself, but give the order immediately to let go in the boat.

I had the misfortune once to be implicated in the loss of a pinnace that was towed under, in a calm day, without a ripple on the water; and therefore know that you cannot be too careful.

In towing a light boat, reeve the tow-rope through the ring in the bow, and secure to the bolt in the keel. If secured forward, you run the risk of tearing the bows out of her.

556. MEASURING HEIGHTS.—Pick a couple of sticks, or straws, and bring one to your eye, holding it horizontally. At convenient distance along it, erect the other at right angles, its height being equal to the distance along the horizontal stick from the eye to the point of section. This being done, approach, or recede from the tree in the direction in which the ground is most level, until the top of the trunk is *on* with the top of the stick. Mark the spot; and the distance from where you are standing, to the foot of the tree, is necessarily equal to the height of the tree from the level of your eye. Pace it off, or measure it in sticks'

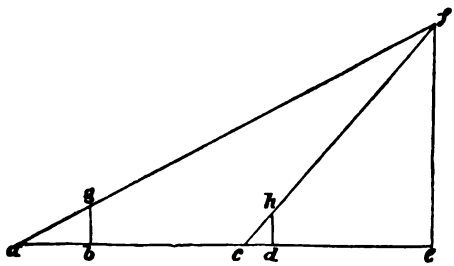
to be reduced to proper
ement on your return on
add the height of the eye,
: result will be the height
tree.



be :: *ac* : *cd*
cd = *be* . *ac*
nd *be*, being equal,
ac.

ıe foot of the tree is at the time inaccessible, bring
:k as before to your eye, and on it, at any distance,
straw vertically; walk back from the tree until the
the straw and the top of the tree are in one, and
ıe spot. Then move the straw its own length further
he stick; walk back until the top of the straw is
n with the top of the tree; and the distance from
the former station, plus the height of the eye, is
ent to the height of the tree.

bg, and *dh* being synonymous,
cd : *bg* :: *ec*: *ef*
ef . *cd* = *bg* . *ce*



Again,

ab being equal to $ad + bg$

$ad + bg : bg :: ac + ce : ef$

$ef . ad + ef . bg = bg . ac + ef . ad$ ($ef . ad$ being substit
for $bg . ce$)

Then, by subtracting $ef . ad$, and dividing by bg, $ef =$

557. To ascertain Distance by Sound.—The m
velocity of sound, under ordinary circumstances, is 1,
feet in a second. In a breeze this must be corrected
proportion to the velocity and direction of the wind, thou
this is not generally important, as its utmost velocity
much less than that of sound. The velocity is not affect
by its intensity, as the faintest sound moves as rapid
as the loudest. One of its greatest conductors is wate
on which it can be heard nearly twice as far as upon lan

Multiply the number of seconds which elapse betwee
the flash of a gun and the report by 1,110, and th
product will be the distance in feet; which divide by 5,28
for an ordinary English mile; by 6,072 for a geographic
mile; and by 6075.6 for a nautical mile.

558. Hawse-pipes Broken.—Knock them out; plac
starboard pipe in the port hawse-hole, and port pipe to th
starboard one. Slue them round, to bring the underneat
and damaged part uppermost, and drive home. Cut th
inner edge off flush where they overlap.

559. Riding out a Gale.—All other things being equal,
the greater the weight of a ship the greater the strain on
her cables.

e weights should not be too much centralized, for
ı in the extremities serves to keep her from flying
like a teetotum. Neither should they be placed
w, especially if the masts are cut away.

ıecessary to cut away the masts, a dangerous
ıtive in a screw steamer, the mizen-mast had better
t standing.

ı. TOWING SPARS.—Tow with the bluff end first, for
ıgh it thus takes more force to start it, it yet requires
ɔ maintain it in motion than with the small end fore-
You also tow nearer to the centre of gravity, and
ıportion do so with greater ease and steadiness.

ıen towing anything in a boat, never make the tow-
ast to the stern-ring, or even reeve it through it, as
ins the boat, and renders steering impossible, except
e oars. When the thwarts will bear it, make a bow-
ınot in the end of the tow-rope, and toggle it with a
her, laid over the two after thwarts. Then, to steer
ɔoat, lift the tow-rope over towards the quarter to
ı you wish to turn. When the strain or jerking is
r, secure the tow-rope to the ring-bolt for the slings
e keel.

ı. FLASHING SIGNALS.—This excellent method of
ılling, invented by Captain Colomb, R.N., after long
careful trial, has now been generally introduced into
Royal Navy.

lashing Signals are made by the motion of any single
ct. In most instances the object is made to appear

and disappear; and in others it is made to change its position, so that one position shall represent the appearance, and the other the disappearance of the object. The symbols are determined by successive appearances and disappearances at regulated intervals, constantly recurring after a fixed pause, in a manner precisely similar to those of revolving or flashing lights in lighthouses. Signals made on this principle can therefore be scrutinized as long as may be necessary to make quite sure of their purport by comparison with the codes, before they are answered, in the same way as any series of flags hoisted together in the daytime may be fully examined before they are acknowledged.

Every signal—consisting of from one to four numeral signs, with or without a special sign, and representing from one to four numeral flags with or without a pendant—is made to recur once in every twenty to thirty seconds; so that an observer watching a signal for three minutes, may see it legibly repeated from six to nine times. This speed is found most suited to general service, and usually the observation of three repetitions is sufficient to make the signal understood, without the possibility of mistake.

The appearances of the object are termed "flashes," and are of two lengths, termed respectively "short" and "long" flashes, which are used in combination, to express the signs required. The long flash is about a second and a half duration, and the short flash about half a second. The disappearances of the object are termed intervals, and are of three lengths. That between the flashes com-

ı figure, is equal in duration to a short flash; that
ı two figures is equal to a long flash; and that
ı any two repetitions of a signal is equal to one-
: the whole length of the signals, or, from about
o ten seconds. Thus it will be seen that the
y of the signals depends on the measurement of
gths of flashes and three lengths of intervals, or
nents, and each is of equal importance. At night
gnals are made by the obscuration and exposure
gle light.

lines opposite each number denote the flashes
express it :—

—	6. ———
— —	7. — ———
— — —	8. ——— —
— — — —	9. — — ———
— — — — —	0. ——— — —

: combinations of flashes are used to take the place
flags and pendants, that have special significations
l to them in flag signals, and are as follows :—

Compass.	——— — ———
Pendants.	——— — — ———
Numeral.	——— — — — —
Special and Repeat.	— ——— — —
Horary.	— — ——— —

Interogative. — — — ——

Negative. —— — — —

List of Navy. — —— —

Alphabetical. —— ——

Answer —— — —— — —— — a continuat
of long and short flashes.

Spelling. — —— —— —

Preparative — — — — — a continuation of sh
flashes.

Stop —— —— —— a continuation of l
flashes.

Horary Table.

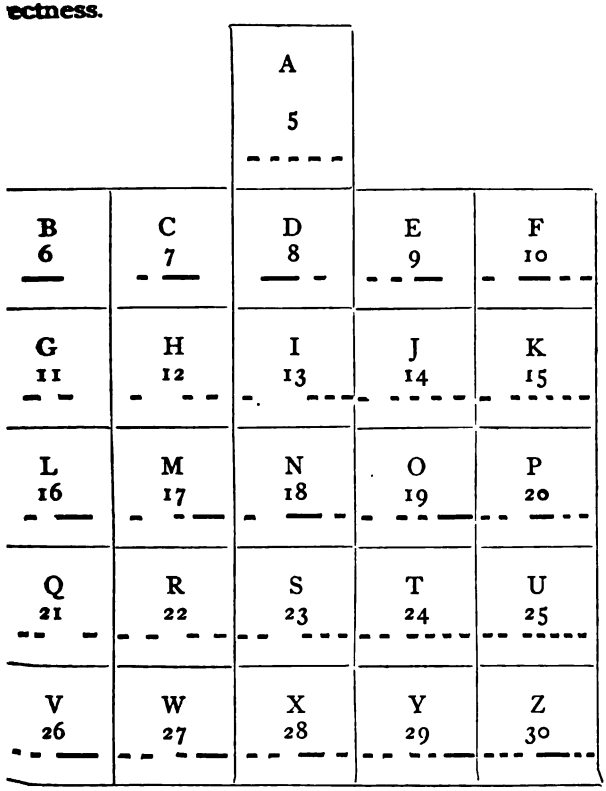
11	1 P.M.	23	1 A.M.
12	2 ,,	24	2 ,,
13	3 ,,	25	3 ,,
14	4 ,,	26	4 ,,
15	5 ,,	27	5 ,,
16	6 ,,	28	6 ,,
17	7 ,,	29	7 ,,
18	8 ,,	30	8 ,,
19	9 ,,	31	9 ,,
20	10 ,,	32	10 ,,
21	11 ,,	33	11 ,,
22	12 Midnight.	34	12 Noon.

Minutes are denoted by their proper figures. *Thus:* Hor. 2135 = 35 minutes past 11 P.M.

Seconds must be made separately.

ALPHABETICAL TABLE.

ıe following alphabet, &c., can be used under circum-
ɔes when it is not convenient or possible to have
urse to the Signal Book, and forms in itself a perfect
raphic system, necessarily somewhat slow in its
ication, but having the great advantage of requiring
little previous knowledge and practice to work with
ectness.



All other lights in the vicinity of a Flashing Si night, should be concealed; signals should n answered until thoroughly comprehended, and no should be commenced until the signal preceding been finished.

562. To find the Time of Daylight and Su —The morning gun is ordered to be fired at day- except when on foreign service, the commander-i on the station shall direct otherwise.

Daybreak, or the commencement of morning tw occurs when the sun is 18° below the horizon.

Rule.—Under the latitude put the declination, na them with their proper names; if they are like, tak difference: if unlike, take the sum: under this, pu constant angle 108°. Take the sum and difference together the log. secants of the two first terms (rej tens in the index), and the half haversines of the tw With the sun as a log. haversine, take out the corres ing angle in time, at the top of the page, which w the time of ending of evening twilight, and which tracted from twelve hours, will give the beginning of ing twilight, or daybreak—in apparent time.

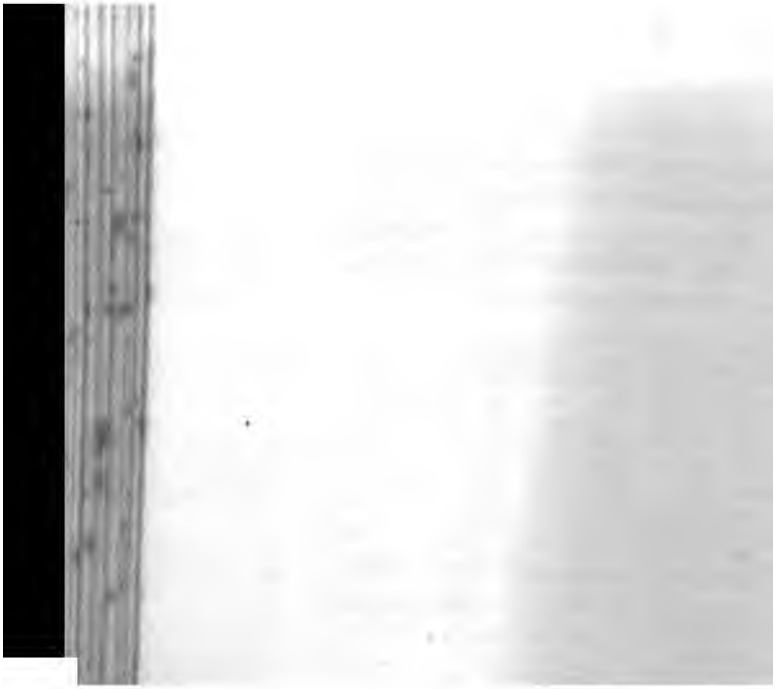
Lat. 22° 17′ N.		Sec. 0·033708
Dec. 15 3 N.		Sec. 0·015158
7 14		
108		
115 14		½ hav. 4·926591
100 46		½ hav. 4·886675
7h. 49m.		Hav. 9·862132
12 0		
4 11	Morning twilight begins.	

E FOR FINDING THE TIME OF SUNRISING AND TTING.—Add together the log. tangents of latitude eclination, subtracting ten from the index. The will be the log. cosine of an angle in time, which if itude and declination are *unlike*, will be the apparent f sunsetting, and subtracted from twelve hours, the nt time of sunrising.

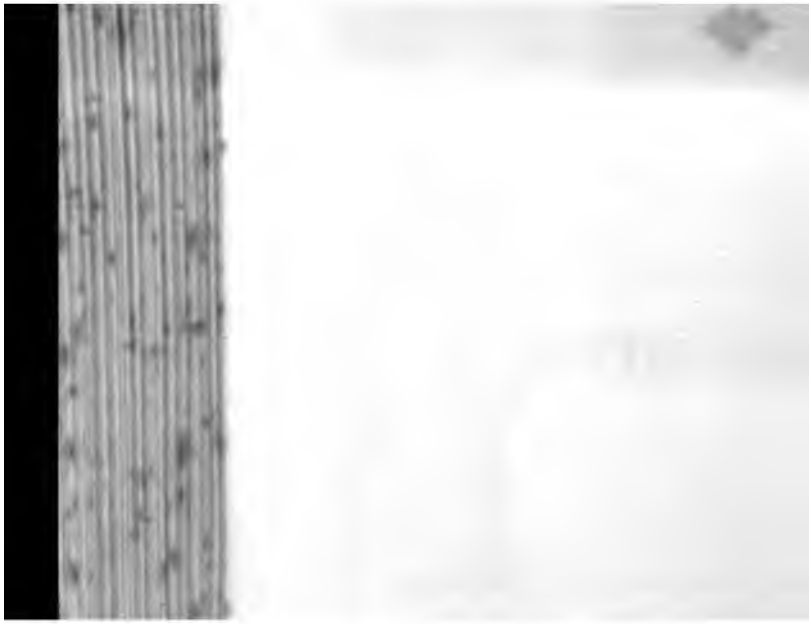
ıe latitude and declination are *alike*, the angle first will be the apparent time of sunrising, and subtracted welve hours, the apparent time of sunsetting.

ıean time (*i. e.* harbour time) is required, the equation ıe must be applied, after the time of sunrising has letermined from sunsetting, and *vice versâ*.

Lat.	.....22°	17′ N.	Tang.	9·612561
Dec.	15	3 N.	Tang.	9·429566
	5h.	35m.	Cos.	9·042127
	12	0		
App. time...	6	25		
Eq. time ...	0	3		
Mean time	6	22 Sunset.		



NAUTICAL SURVEYING.



NAUTICAL SURVEYING.

The word SURVEYING is often deterring to the young [illegible] as signifying something with which he has, and [illegible] to have, nothing to do. It is intended here to [illegible] out and briefly explain the useful work of this kind [illegible] can be accomplished with the instruments to be [illegible] on board of every man-of-war, and with which every [illegible] should be acquainted, and be competent to perform.

There is SURVEYING of a more accurate and extended [illegible]acter requiring instruments, means and opportunities, [illegible] to be found in surveying ships or organised surveys [illegible] coasts: Surveyors are employed on this work, the teach- [illegible] of which is not contemplated here.

ON THE INSTRUMENTS.

These are necessary;—sextant, artificial horizon, chro- [illegible]meters, hack watch, azimuth compass, box of instru- [illegible]nts, parallel rulers (if with graduated edge the better), [illegible]mmon horn protractor, and tracing paper, and these are [illegible] be found on board every man-of-war; whilst a theodolite, [illegible]nding and pocket sextants, a circular or semi-circular [illegible] protractor with vernier, a station pointer, and a [illegible]ree-feet metal standard scale, with bevelled and perfectly [illegible]ight edge, are valuable in extending and greatly facilitat-

ing the performance of the work, and placing it on pape
the use of these latter is strongly recommended to be a
quired : a little practice under instruction, or guided by
"Treatise on Mathematical Instruments," would soo
make any enquirer acquainted with it.

PREPARATIONS.

These preparations are such as should be made o
board every man-of-war before starting on a cruise, whethe
with a purpose of some surveying work, or merely as a
preparation for any that may offer; they are especiall
expected from the Navigating Officer, and therefore he
must be competent to make them, but they are such as
every young officer ought to be equally well acquainted
with. The chronometers, most likely three in number
on being brought on board should be placed carefully in
a box prepared and divided into compartments, and fixed
therein firmly by small pads, bits of buntin or tow, jambed
in around them : a place for the *Chronometer box* must be
carefully chosen, low and near the centre of the ship is
desirable, but access, light, liability to vibration as of
machinery, and especially the importance of equal tem-
perature, are all considerations that must determine the
spot. The box being fixed and the Chronometers stowed,
let them rest a few days, and then ascertain their errors
and rates. "Equal altitudes" of the sun is by far the best
method, and the practice of taking them is this :—compare
the hack watch (a chronometer whose performance is trust-
worthy for a few hours) with each of the three chronome-

nd proceed with it at a suitable time. A.M. to the : with sextant and artificial horizon observe two or sets, with intervals, so as to increase the chances of osing the whole of the corresponding P.M. sights by ls; return on board and compare again. Compare return to the shore at the proper time, P.M., and plete the observation, and compare again, on finally ning on board. From this will be deduced the error ach chronometer at noon of that day. Repeat this rmination of errors about a week afterwards, and then each few days, up to the latest convenient day before ng, and comparing these errors with the number of sed days, you get the rates of each chrronometer.

he Chronometer esteemed the best is usually selected "Standard," and with it each of the others is compared ie time of winding daily; the comparisons entered in ook, the "Chronometer Journal." To wind at 8 a.m. ost convenient on board a man-of-war; the time, how- ; is unimportant, regularity, every day the same, is ortant: turn the Chronometer over from right to left, hold it firmly there by the left hand; turn the key slowly steadily, and more cautiously still, as the known last comes, until it butts, withdraw the key and turn the onometer back with its face upwards; in turning either , it is liable to slip out of the hand. By the method qual altitudes, the error of a Chronometer is most ectly obtained, and any error there may be in the ant used does not affect the result; but it is not always ticable to observe equal altitudes, especially in the

cloudy weather of temperate climates; the a.m. sight are often obtained, the p.m. lost; in such a case the error must be obtained from single altitudes (the a.m. or p.m. sights of equal altitudes can be rendered as single altitudes) but in these cases it must be remembered that those rate only will be trust-worthy, which are deduced from similar observations: thus, the errors obtained by equal altitudes one day, should be compared only with errors obtained by equal altitudes after an interval of days; the errors obtained from a.m. single altitudes, with errors obtained by a.m. single altitudes, after an interval of days; and so p.m. with p.m.

In using a mercurial artificial horizon, wipe any dirt or dust out of the trough, place it nearly in its position toward the sun, and to pour out the mercury, turn the vessel completely over, and do not pour out the whole of it, the scum or tarnished part keeping on the surface, will be each time left behind in the vessel. When half the observations are made, turn the roof, whereby the errors in parallellism of its glasses will be obviated. In hot climates and especially at night, an unaccountable dimness sometimes comes over the observations, which has been found to arise from condensation on the inner surface of the glass roof of the horizon—take it off and wipe it dry when necessary.

An important preparation, and one that has to be repeated, with every material change of geographic position, or of situation of iron on board, is the determination of the deviation of the compass; there are three

venient methods of doing this; first by reciprocal rvations, with an assistant on shore; secondly, by ing of a distant object whose true bearing is known; thirdly, by bearings of the sun, the apparent time latitude being known. The first is most suitable close harbour, or when cloudy weather prevails; second is better if there be no reliable assistant, would involve more work if the true bearing e distant object and variation of the compass, not previously known; the object must always distant as not to affect the bearing by the swinging e ship when moored or hove short if at single anchor; the third is especially used at sea, when of course, the two methods are impracticable. Tables of "Sun's bearing completed for intervals of 4 minutes between parallels of lat. 30° and 60°, inclusive," which give this t by inspection, are supplied to every ship. The tice of the first method will be described.

he "Standard" Compass is the one whose deviation is rmined, its position most likely is more available for erving, but the steering binnacle compasses are com- ed with it at the time of each observation. The Standard mpasses supplied to H.M.'s Ships are faultless in quality convenience, each has two cards A and J, one heavier n the other; selecting one and noting which it is, amine the pivot and see that the card works freely on s centre; record the kind and distance of the nearest on, and the distance of the largest masses, for the guid- nce in comparing any future determination after changes; oist a flag or other mark, directly over the standard com-

pass, to be observed from the shore, as the compass ceases to be clearly seen at very short distances. The preparations for swinging her being ready, either by hawsers, to buoys &c. near or kedge, or by steam assistance; the ship moored or hove short if at single anchor; or underweigh under steam, if intending to put her round underweigh, place the ship's head towards any convenient point of the compass, and hoist an agreed signal to the dip to "stand by"; the assistant having landed the azimuth compass, with legs, previously examined as to its working order, and selecting a spot free from any iron or influences to affect the compass, and where the ship will be plainly visible through her swinging, now begins to observe the flag or mark over the standard of the compass. As the ship's head approaches the desired point and being steadied there, hoist the signal close up, each observer now closely takes the bearing of the other, and records that of the moment when her head is fixed on the desired point, and the signal smartly dipped low: each observer numbers and records each observation, and it is better that each should note the time also by watches compared, for future guidance; this is repeated with the ship's head on each point of the compass. In this method the bearing observed from the shore is the true magnetic bearing, the bearing from the ship should be exactly its opposite, what it differs is "Deviation."

APPLICATION.

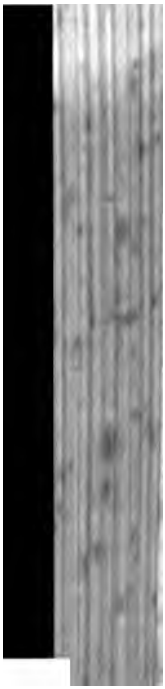
Thus prepared, the ship leaves a port, and in due time reaches another one: the first piece of useful work is to

: the "Meridian distance" of the two. As soon ble get equal altitudes, and as before, find errors es of the Chronometers. The rates determined tarting, and now on arrival are assumed to give an rates of the interval, with which data the ment is thus computed, and more clearly explained lation.

ate Meridian distance between Stornaway and Thorshaven.

TES, ETC.	CHRON. A.	CHRON. B,	CHRON. C.
	H. M. S.	H. M. S.	H. M. S.
M. T. Stornaway, T., 9th Aug., 1868.	Slow 4 17 16	Slow 4 2 2·1	Slow 4 22 39·6
aving Stornaway	Gaining 1·02	Gaining 4·42	Gaining 1.92
mined on arrival at ven	Losing ·56	Gaining 2·57	Gaining 1·04
e	Gaining ·23	Gaining 3·5	Gaining 1·48
8 days	× 8	1 × 8	× 8.
ed Rate	1·84	28	11·84
M. T. Stornaway, T., 17h.	Slow 4 16 59·8	Slow 4 1 34·1	Slow 4 22 27·8
M. T. Thorshaven, T., 17h.	Slow 4 15 27·5	Slow 4 0 3·5	Slow 4 20 .54
	1m. 32·3s. 1m. 30·6s. 1m. 33·8s.	1m. 30·6s. Mean oh. 1m. 32·2s.	1 33·8

is computation Thorshaven is made 1m. 32·2s. West naway: and in this way the longitudes of places en, and are, determined by our surveying ships, and w be verified, and new places done by any other war, only so much less reliably, as the usual num- three chronometers is less than theirs. It is not



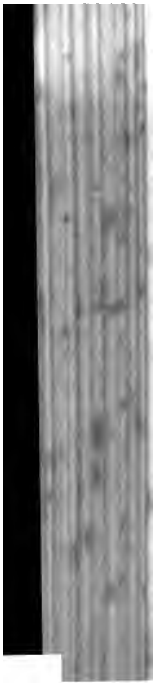
found only in an observatory, or the
other, the absolute longitude of any o
chain is reliably ascertained, the lon
may be assumed to be known for all p
or navigation. If somewhat greate
attempted, the "mean rate" can be red
of least squares," whereby a series
errors being made first at one place a
the rate is determined at the time of t
and first of the latter, (and not at the
of each series as in the simple plan,)
in which change could take place is
have true rates at each end of the
the rate is the soul of the interest
"Meridian distances." The remarks
ometers, about comparing the results
a.m. and p.m. sights, with their fellow
vital importance.

LATITUDE.—The latitude should al

th are better still if the altitudes are observed on shore, th artificial horizon: in and near the tropics it is often possible to observe the sun's m.a. in an artificicial hori-n; the sun being too high the observer's head intercepts or the graduation of the sextant is less than double the itude: this has often been experienced when fixing s in rivers with no natural horizon; then the moon's . may often be observed, but far better are the meridian udes of several stars, some north and some south.

It is recommended to make a practice of observing the ex error of the sextant before or after every observation day (by joining the sun's edges off and on the arc) and ording it: it prevents your ever losing your labour by ding too late, your sextant has been shaken without r knowing it, and gives you confidence in the fixedness its error: its other adjustments should be frequently oked to.

Variation of the Compass.—Charts of curves of varia-on, over the whole world, are supplied to H.M.'s Ships, hich give it quite near enough for purposes of naviga-ation, but it is a datum which should be independently scertained on shore at every opportunity, for it is ever arying with time and place. Proceed thus: examine the ompass, land with it, select a spot free from the influences f any iron, and from which some distinct and well defined bject, distant at least three or four miles, is clearly seen; t may be the sharp top of a mountain, a sudden cleft in a idge, a perpendicular cliff on the horizon, a white sandy atch, edge of a clump of trees, church spire, or anything



these for the *magnetic* bearing, which c
true bearing of the object from that sp
How to determine the *true* bearing, whi
and in any attempt at surveying that n
any where, will be explained. Or if th
the rising or setting sun be visible, o
amplitude and compare with the com
for variation.

Or, when landing for a.m. or p.m. sig
pass to the spot, observe a set of sun's
times, while an assistant observes th
them, compute the true azimuth, and
observed one for variation. The same
take the altitudes, by taking a set be
after his set of azimuthal bearings, and
proportion to the moment of that be
desirable that every observer should pr
for himself with all observations—the ey
become accustomed and proficient—a
will often be preferred.

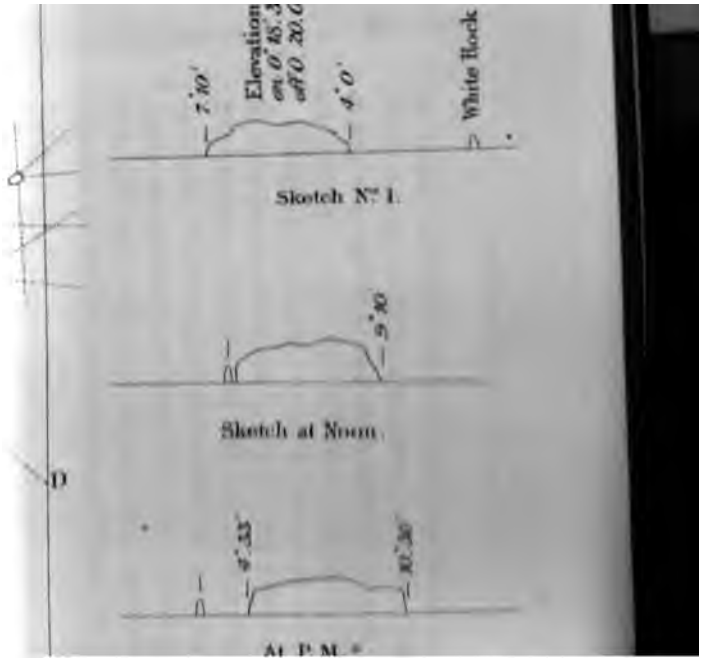
tance between the edge of the sun and a conspicuous ject (in a survey, the other end of the base), which uld be close to the horizon, in order that the elements y form a quadrantal spherical triangle, and simplify calculation; if it be above it, another computation is uired than the one to be given below; the object need be the same as observed for variation, and, indeed, better not be if the latter were a hill-top or something above the horizon. From the observed find the parent altitude and reduce the angular distance to the n's centre, then from log cosine of distance take log sine of sun's apparent altitude, and the remainder is log sine of the horizontal angle between the sun and the ject, or their difference of bearing; and the sun's true aring being known; that of one terrestrial object becomes own also from one known spot. If the object observed r variation be high, repeat this measurement between and the point now determined, by measurement of its itude and their angular distance: but in practice, e horizontal angle would be observed at once, not of urse to the top of the hill, but to the base of a perpen- ular from it, which the practised eye would fix at once the sextant. But at first a plumb line may be held up at me distance from the observer between his eye and the p of the high object, to find out this perpendicular. It to be understood that an artificial horizon must be used en the natural one is not available in measuring itudes for this or any other purpose.

If the horizon with the rising or setting sun be visible,

the measure of the horizontal angle between the
if it be not much above the horizon, and the risi
setting sun, applied to the true amplitude, gives a
true bearing.

The tides.—The tides present so many eccentric
different places, that very close and long co
observations, and records of these are necessary to
tain them: but no opportunity should be lost of ob
them, and when they are normal it is simple enoug
up a tide pole, which may be a batten marked,
and sub-divided by lines, and secured to some
object, as the piles of a jetty; or it may need to be
into the ground independently, in which case it n
closely watched for settling down, whilst the level o
mark on it should be referred to a rock or object on
to enable it to be replaced if by accident it sho
removed during a series of observations; or the
dicular side of a tide-washed rock may be ma
fortunate enough to have one; the spot selected
sheltered, yet with free access from the sea, and wh
gauge may be conveniently read by night and
and with its zero below low water at springs.
it be remembered, that which is principally wante
ascertain the time of high water, at full and change
moon (commonly called the *establishment*, becau
being established, the time of high water on any otl
can generally be known), and the rise at springs
neaps. The observation should be begun by notin
height every half-hour for a complete 24 hours, to as
whether at the particular place, there be the usual tw

DIAGRAM N° 1.



C

E.

Noon B

D

a day, or only one in four, or any other peculiarity; en, if their be nothing unusual, note the time and height every ten minutes from half-an-hour before to half-an-ur after every high and low water, day and night, and be complete, this must be continued at least through a ar month. Let the watch used be set to mean time d the observed times of high and low water should be ily compared with that of the moon's transit, for the tide ould follow this transit regularly; and if it be found not do so, it indicates peculiarity, that there is no proper *blishment*, and that the common method of observing e tides will probably be valueless. Whilst any sounding going on, the tide gauge should be watched and gistered every half-hour, or at any material sudden rise fall, to enable the soundings to be reduced to the level *low water springs*, for placing on the chart.

On Passing an Island.—Having lately left a port where the Chronometer was rated, &c., let it be supposed that an land is passed, whose position, extent, and general outline, it is desired to ascertain, whether from it not aving been done before, or any other reason.

(See Diagram 1.) Suppose the ship arrived at A, and the ime 8·30 a.m., suitable for sights; stop or heave to and bserve thus—take the angular distance from the sun, to a onspicuous off-lying rock, to the right (choosing it because is more easily recognized again, than any other point hosen might be) for its true bearing; observe its bearing by tandard, measure with sextant the horizontal angles be-ween white rock and each extreme of the island. Set

the patent log and put it over; let the ship proceed her course if it is not wished to delay at all, otherwise on such a course and rate as would bring her true of the island at noon. In the diagram she proceeds her course, N 60° W., by compass; it is essential that ship be carefully steered; a practised hand would make all these observations without stopping the ship, especially with an assistant observer. At noon, stop, determine the latitude by sun's mer. alt., and the whit may be supposed to be just coming open of the le ble extreme of the island: observe its bearing by st (and remember whenever a bearing by standard, served the direction of ship's head, at the moment be observed also); measure the angle to the right e of island, read the patent log, and put it over Proceed on the course, the ship steered carefull when the sun is suitable for p.m. sights, the island, ar being still plainly seen, stop (if necessary), take true and compass bearings, and angles as before in and read patent log; and now is collected all th necessary for fixing the island correctly, supposing th no current.

If the noon position were in the parallel of the (the island bearing true East or West), and one posi time of sights either a.m. or p.m., had been on its me (the island true North or South) about D and E two would have been enough, and the position island would have been determined most favorably to arrange this, the distance from the island at wh

in, course of ship, and rate of going must be regulated ording to circumstances.

The ship need not be steered on any one course, (though better), but her course and distance, by reckoning, st be very carefully determined, from one fixed station to other (A to B to C) and applied to those positions as d by observation, as the best available means of detect- current.

f the water were moderately shallow, and especially if ng this work under steam, whilst stopped at stations B, C, a kedge were dropped, and the direction and rate the current ascertained, the observations &c., would better made, and the whole task performed with much re exactness. To ascertain the height of the island: n one of the fixed positions observe with a sextant its gle of elevation above the horizon at its base, off and the arc; mean these, and with height of eye and its tance from that station (determined afterwards in the tting), its height is readily calculated.

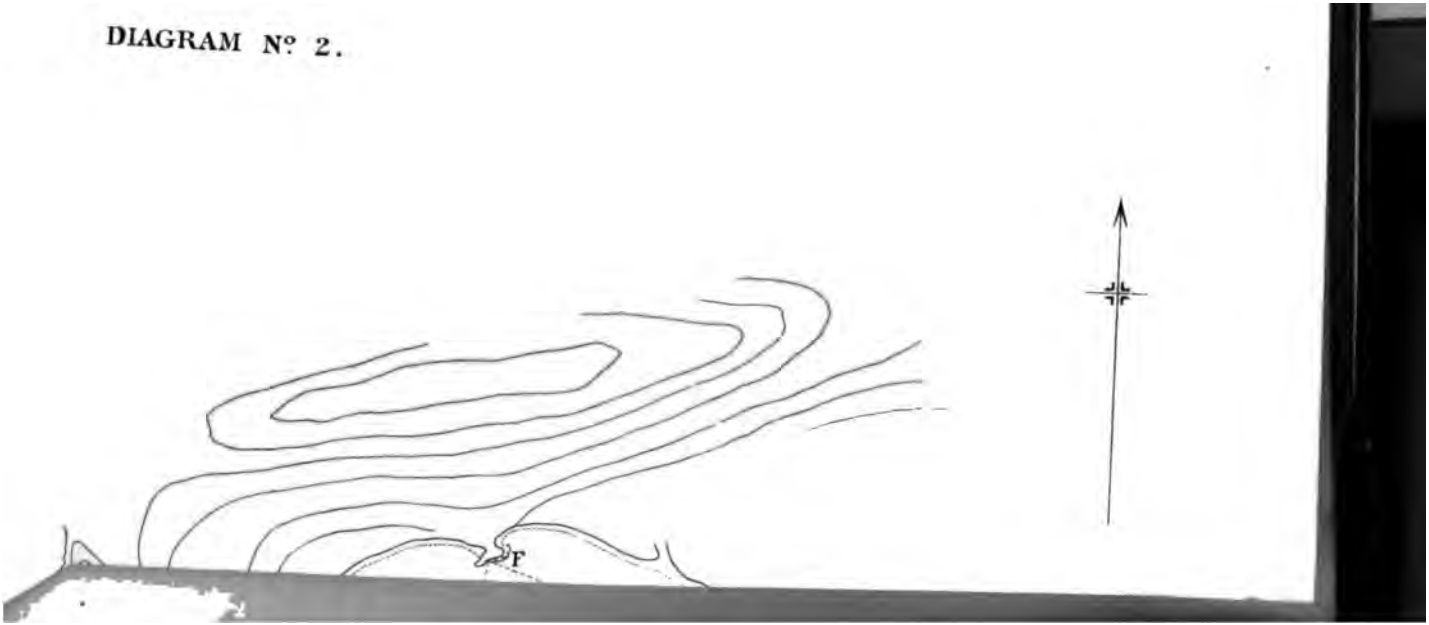
To put this work on paper.—(See diagram 1.)

Choose the point A, and draw a vertical line through or the true meridian, and set off from it the true bearing the white rock; then from this line as zero set off the gles observed to the extremes of the island. Having ected a convenient scale, lay off from A position, B d C relative to A, as determined by the astronomical servations, courses and distances made good by reckon- , and the current ascertained from the two. Now set from B, the bearing of white rock and angle observed

to the extreme of the island: the intersection
lines mark the spot of white rock and the limits of
From C lay off again the true bearing of white
the angles observed to the extremes of the isl
intersecting the previous lines mark the limits of
more nearly, and should pass through the point
section for white rock. If it does not, supposing
to have been made in any of the observations, i
current which could not be ascertained, and the
tions from the two positions estimated to have
affected by it should be used only. On the pape
the true bearing and distance of the white rock
of the stations, and their lats. and longs. being kn
of the white rock is determined, and a small
Mercator's projection may be made, including
compass bearing of white rock having been
when its true bearing was taken from A, the varia
deviation being known, you ascertained the whole
error and so were able to observe with it and la
true bearing of white rock from B.

This operation is often applied conversely and
usefully in navigation, where a ship after a sea crui
ing an island or head-land, well known to be acc
fixed on the chart, the navigator determines in the
way his position with reference to it, and comp
with that determined by his chronometers, finds the
errors and proceeds on his voyage with confidence.
the same is in daily use when sailing along a coas
wished to be certain of the distance from any obje

DIAGRAM Nº 2.



earing of the object or light,
istance run for an hour or
cumstances, (taking care to
and then another bearing of
ether on the chart fixes at
at the times of both observa-

now arrived and anchored in
posed to make a plan (see
pot A, from which the whole,
l to be worked in is plainly
r latitude, meridian distance,
of an off lying rock at C.
ıay be carried on either by
ı station, or by fixing a sheet
, and carrying it about, and
on it at each station. The
ot be considered the base of
it is as easily measured as
able proportion in length for
ithin the work, it is used as
t be chosen, and this choice
embering that triangles are
lateral, and that none would
hen one of the angles fell
is a spot from which the
to be worked in is plainly
ms sides A B, B C, one or
the circumstances of each

case, upon which further triangles may be cons
with new points within the work. Thus on A B a
structed A D B, and A B E; and on A E is cons
A E F. Set up at each station A B C D E F,
with cross boards at right angles at its top, or a
washed cairn of stones, or other good mark, and m
carefully the horizontal angles of each of the tr
formed at them; and when the three angles of
triangle are added together and make 180°, this p
the work has been done correctly; very often it may
cessary or convenient to calculate a third angle of a
angle, by subtracting the sum of the other two from
without observing it; and sometimes in measuring
with a sextant, the angle may be beyond the capacity
instrument; in this case measure two, choosing som
spicous natural mark between them and add
together.

Now construct this triangulation on the paper;
A C may be assumed any convenient length; and
any one side of the triangulation is by-and-bye mea
the scale will be ascertained and put on the plan
more formally and better, measure one of the side
matter will be treated of after), and from it and the l
angles calculate the lengths of all the sides in a
triangles. Then drawing a line for the true merid
A, set off A C its true length, and on its true bearing
on it build the triangulation by the sides with a p
compasses and scale. A triangle is more correctly
down by its sides than by its angles (in large work
done by a beam compass).

Now each station must be visited, and by lines of intersection, all the various points and objects lying between these stations must be cut in, and the coast line completed by hand and eye as you go round. It may also be necessary to whitewash large stones, or set up poles with a flag or cross boards nailed at right angles at the top, where there may be a long interval without any natural mark. At first it may often be necessary to visit a station more than once, but a very little practice will generally obviate this and curtail the work, in many particulars, in fact, teach the *surveyor* to kill two birds with one stone.

It must be rembered that much may be put in beyond the triangulation, as the seaward side of the bay in the diagram if it be seen from sufficient of the points, but it is generally better to extend the triangulation, so as to include all the proposed work. To sound this bay, and search for shoals, and hidden dangers, and ascertain the nature of the bottom, and so the best parts for anchoring, the better way would be to sound in lines north and south parallel to each other, beginning at the western end, and at such distances apart as the variation of the depths allows to be necessary. To do this, an assistant places two poles in line, north and south, on the north shore, a few hundred yards apart, fixing by angles the spot of one of them, and thus the line is shown across the bay, on which the boat sounds by keeping them in line ; the point in this line is fixed at short intervals by observing from the boat an angle between the line of the poles, and any

other station or object fixed on the plan on either
the line, making any angle from about 30° to 150°
As the sounding is performed more frequently th
necessary to fix, place the intermediate ones propor
Supposing the boat to have left the south sho
sounded towards the poles on the north, she reac
shore ; the poles are placed on a new line to the e
and the boat re-crosses the Bay, with her stern
them, and thus backwards and forwards until the e
of the Bay is reached.

But without this assistance from the shore, sc
is thus performed ; remembering that the positio
sounding is fixed by quickly observing two angles b
three objects fixed in the work, that the centre
should always be the nearest, and that angles from
90° are best. Starting from one shore note any tw
spicuous objects on or nearly on with each other.
direction which it is intended to sound, and this di
must be decided upon by any tide there may be.
which the marks will be most favorable. Fix the
starting and sound, pull in the direction, keeping tl
going and recording the depths and nature of the b
Every now and then, according to the speed of th
fixing afresh, making a tick against the sounding
instant, and whenever any important change in the
or bottom takes place, until the shore is reached
direction determined : fix again there and proceed in
direction until the bay has been sounded over, leav
considerable unsounded spaces. It will often be nec
to change the objects for fixing, the time should

bout every half-hour to enable the soundings to ed to L.W.S. Any two fixed objects in line or ith one angle right or left of it makes a fix of great y. With three objects in a curve concave to the , or the middle object farthest from him, it is difficult, and sometimes impossible to fix; this e avoided; but it may sometimes be necessary . compass bearing and an angle.

ut these soundings on the plan, first reduce them S, and then on a sheet of tracing paper assume a id lay off three lines, measuring the two angles d between them, and putting the names or initials bject on each line; let the lines be long enough, ve the tracing paper about on the plan until the nes pass through the spots of the respective objects; ith a needle, prick through the assumed spot on the paper, which is the spot on the plan of the corres- g sounding which was ticked, which introduce l. Plot the next ticked sounding in the same id then fill in the intervening space by a selection ortion, of the intervening reduced soundings, and l thus through the whole.

tides having been attended to, a fair copy must e made, and scale attached; denote latitude and de of the observation station, calculated from the in distance, and name the last known meridian ed from variation of the compass; time of H.W.F. , with rise at springs and neaps, and the standard h the soundings are reduced, usually and properly .S., should be appended to the title.

If any sketches, however moderately well executed, c be appended, so much the better, and especially of obje used as marks, or likely to be alluded to in remarks the place; and the height of one or more of the princip hills, if there be any, should be ascertained and shewn.

On Measuring a Base.—We have illustrated a bas measured by the latitude and longitude, both ends of being determined astronomically, and alluded to a bas measured by a distance run by Patent Log; now in the case of a plan of a harbour, the best method is to arrange the triangulation, so as to bring one side of any one of the triangles along a sandy beach, or level piece of land, and this being actually and carefully measured, the actual measure of every side in the triangulation is readily calculated by the sines of the angles being proportional to their opposite sides.

Or, since the height of the truck of every man-of-war above its netting and water-line is known, or can easily be found, if in the plan before us, the angle of its elevation be observed from B and from D, the distances B to ship, and D to ship are calculated, and the horizontal angle made at B and D with B D and the ship, or the included angle at the ship, "D ship B," observed; the side B D is easily calculated, and from it again all the other sides in the triangulation.

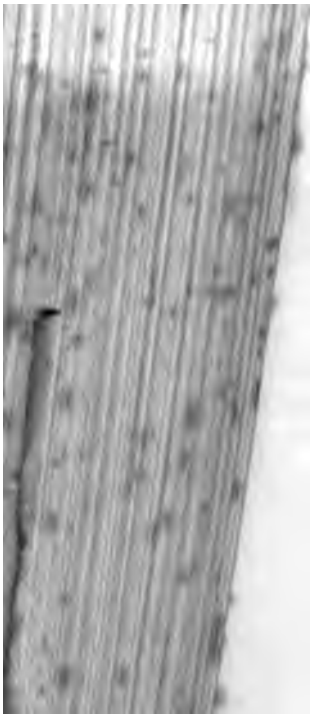
Again, when the distance to be measured is considerable, extending over a mile, it may be more convenient to measure by sound, though it can scarcely ever be so accurate. Send a boat's gun to C, while you are at A, with the hack watch, between which two stations it is proposed to

are the distance. Now the watch may beat every half-
nd or five times in two seconds—when every beat
s four-tenths of a second.

range a signal to be displayed at C, ten or fifteen
nds before the firing of the gun; now with your eye
, and fixed on C, and your ear and half an eye if you
it, left on the watch conveniently held before you,
to count aloud the beats, remembering, or an assist-
noting the beat at the moment of the flash; do not be
rbed by it, but count aloud steadily, stopping the
ent the report is heard,—you have now the number
eats between the flash and the report, and so the num-
of seconds and tenths of seconds: now the flash is
med as instantaneous, it took no time to travel, the
rt travelled at the rate of 1090 feet in each second,
he thermometer showed 32°); therefore, multiply 1090
he seconds and tenths, adding one foot for every two
ees of the thermometer, above 32° Fah., and you have
distance A C in feet.

r to avoid the trouble of landing a gun, the ship her-
may fire, and you may make the observations at one
nore of the stations, and so work into the triangulation,
n the case of observing the truck's angle of elevation.
t would of course repeat the firing and measuring until
similarity of results showed there was no material
r in the practice.

l *River Survey.*—If it is wished to make a careful and
plete survey of some miles of a river, with time to do
n, and supposing its banks and adjacent country to con-
of hill and plain, all accessible, a base should be



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tained
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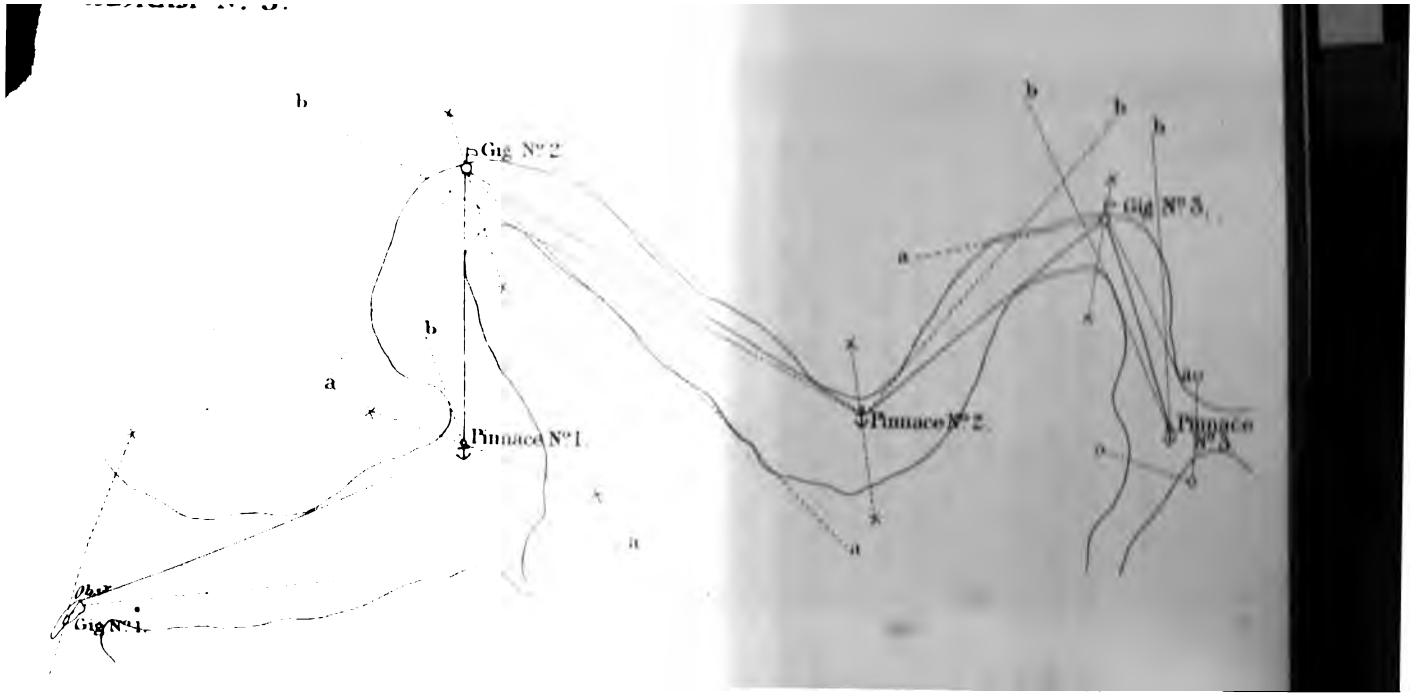
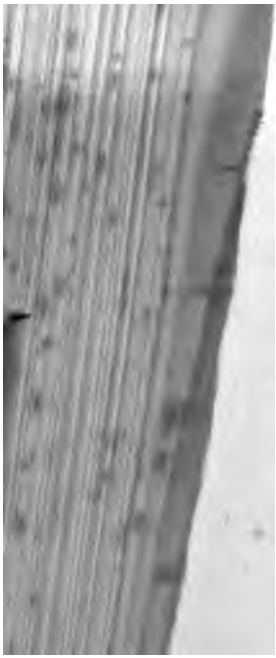
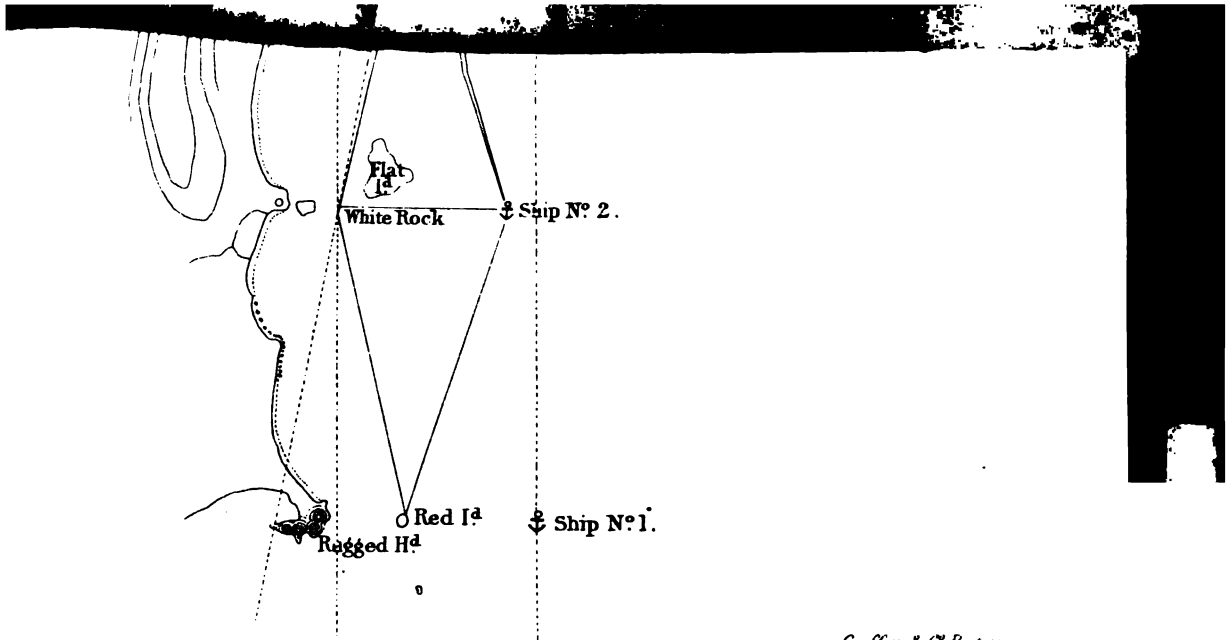

b
Gig N° 2
b
a
Pinnace N° 1
Gig N° 4
b
b
b
Gig N° 3
a
Pinnace N° 2
Pinnace N° 3
a

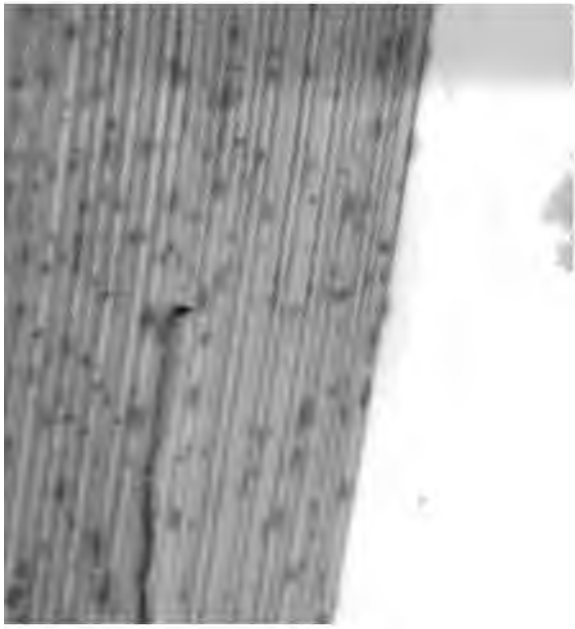
Wherever you may halt for an hour or so, or after ping for the night, or before starting in the morning, would make a fuller plan of that part of the river, suring its breadth, and cutting in all points in sight up-down; measuring a base by running a line along iece of level bank, or by sending the boat across the er from where you are, and observing the altitude of mast.

Supposing you finally attain some considerable ance from the sea, it is more than useful to ascertain e height above the sea level, by continued registration an aneroid barometer and loose thermometer which you uld compare with the mercurial one on board before ving, and on your return: and also to determine the iation of the compass.

Lastly, (see Diagram No. 3.) suppose you have two ats, but only a day or two to do the most you can in; if ere is a reliable assistant in the second boat, more work ll be done, and it will be better done, but if there be ly yourself, (as is assumed generally in these remarks), ke the gig and send the pinnace to the first point of the er you wish to fix; she should always sound as she oceeds up the river; her mast should be stepped, and rhaps a lighter pole lashed to lengthen it, the top made nspicuous by cross boards or a signal cone, and the dist-nce carefully measured from this extreme top to the at's gunwale. Arrived at the point you have sent her to, e anchors or is fastened to trees or a rock, as close the hore as she can. You observe the angle of elevation of her ole (always off or on) and take the bearing by azimuth com-



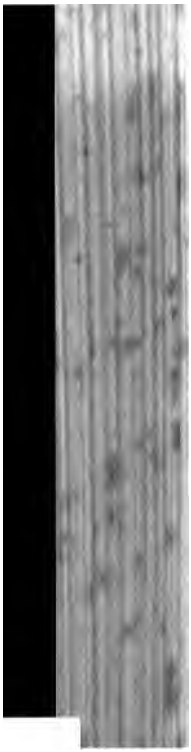

Flat Id.
White Rock
Ship N° 2.
Red Id.
Ship N° 1.
Ragged Hd.
Griffin & Co Portsea



hen time or circumstances forbid your proceeding
er, it would be of great value to your work to land
your azimuth compass and take a run to the top of a
moderate hill which you have included in your angles,
from it take a bearing of the ship herself off the mouth or
mouth, or your first station, or any of the most salient
s of the river, or hills, or noteworthy objects, any
l of them. There is a point up every river beyond
h the influence of the sea tide ceases to be felt; a
or two's trip would not probably reach this, but on an
nded trip it should be ascertained.

Nomendature.—In all surveys, but especially in extended
r surveying, names for villages, islands, hills, distant
ntains, branches of the river, and of the river itself,
(for it varies), will be wanted; always ascertain if
ible, and use, the *native names.*

COAST SURVEY.—It is proposed to spend a few days off
iece of coast for the purpose of surveying it to the best
our ability, supplied only as before with the means an
inary man-of-war affords; let it be supposed that the
re is inaccessible, the ship is abreast Red Island (see
gram No. 4) three or four miles from it, and the time
table for beginning the work. If the wind, weather, and
pth of water admit, drop a kedge say at position No. 1,
ke a rough outline sketch of the coast from Red Island
Flat Island, and observe the true bearing of any distinct
ject, say the peak of Red Island; take angles between
and the limits of Rugged head, and of Flat Island, and
White rock, the point behind it, and to any hill top,
use, rocky point, limits of sandy beach, or every other

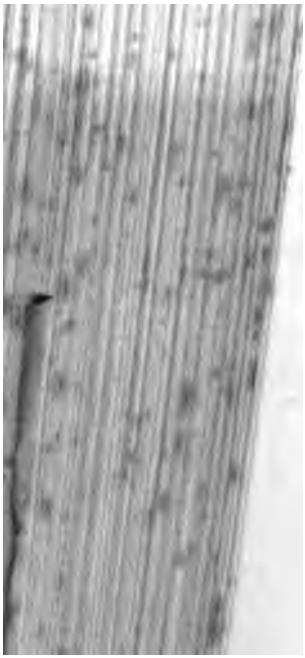


and of off-lying islets or islands,
force, and changes if any, of the tide,
at anchor; now weigh and steer a ste
No. 2, sounding as you go, though
to plot these soundings yet, the o
having yet to be fixed, and heave
until arrived at a position off Flat
coast you have passed is clearly in
kedge again. Remember with refe
Log, that any one drawn from stor
once to be depended on; it may
error, which can only be proved
actually ascertained distance; if it
rected, but perhaps it is better to n
allowance whenever it is used: the
to sounding machines, and in bo
Patent" are particularly correct
instruments are like first-rate watche
ing, or their known and constant irre

Besides your rough outline sketc
time have prepared a projection.
your position, No. 1, lay off from it
bearing you observed, and then the

ius, aided by your sketch, you fill in the coast line Red Island to Flat Island. You will fasten at 2; ingles of notable objects to the northward; make a ; observe the tide, &c.; and then proceed to any n farther on, say 3, and repeat this work until your r purpose is suited. You have now a map of a of coast line, with all conspicuous objects duly fixed it, you can proceed to complete the sounding by ng off and on the land, fixing and sounding. How stand off must be regulated by many considerations, er the shore is steep, and of great depth, or gradually wing; whether the land be higher or lower, and the ou have to spare, &c.; but how far to stand in would gulated by considerations of safety to the ship; er you are in a sailing or steam ship greatly alters ork of sounding: and finally, you would examine in it the whole shore, standing off and on, sounding the limit of your ship work, you would complete roborate the sweep of the bays, and look carefully idden dangers, especially off the projecting points, er of mainland, or off-lying islets and islands. At of your ships positions at anchor—but certainly, if le, at the first and last, you would have made rations for true bearing, and for lat. and long., and nnecting the ship's position with the shore, you fix mits, and introduce your surveying work between

It may not fit exactly; you must decide upon reater reliability of your astronomical, or trigonome- ita, and amend the work accordingly. For instance, s case with the coast, nearly north and south, great



to the sa
Flat Islan
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steadied with
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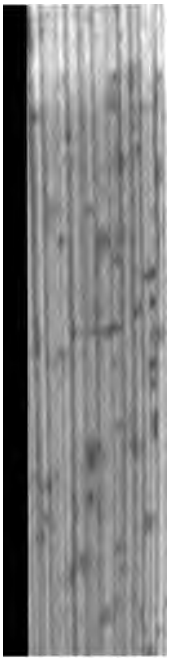
a gig; and th
If there be but
for the correct
survey is based,
ing and accord
The work is sup

will survey and sound the coast between Rugged Head White Rock, and then return to the ship.

The assistant left on board the ship will take angles be- the principal objects and White Rock, from the mast, at each gun; then angles to *all* objects that are to be in any way useful. True and compass bearings one conspicuous object should also be taken, as well angles of elevation of the principal peaks. Here, Red Head is the principal object on one side of White Rock, Cone Mount on the other; next in importance is ble Head, then High Mount. As it is intended to the survey along the coast to the northward, recon- re well with a glass in that direction, and take angles ween all remarkable objects and White Rock. Some hem may turn out to be of greater importance than is irst expected.

The principal having left clear directions with his assist- on board the ship, to ensure combined action, proceeds self to white Rock, with chronometer, sextant, &c. the time he lands, pinnace may have arrived at Red nd, then he, being ready, will make an agreed signal the ship to fire, for measuring a base by sound. Ship l answer by hoisting a large flag at the fore, *half-mast;* n the gun is ready hoist it close up; and dip to half- st again, the instant *before* firing. Repeat thus thrice, ntervals of about three minutes, and thus the distances l Island to ship, and White Rock to ship (No. 2) are ained. At the time of firing, angles between the princi- objects are taken from the ship, and from observatory ion at White Rock; these angles, as well as the inter-



the coast. When all is complete, ship w
and anchor conveniently near ol
Pinnace will sound and survey the coas
Head and White Rock.

.Each observer should place his an
sketch of the coast, as well as recordin
book.

The Chief, at observatory station, wil
with observations. He should note th
directly he lands, and occasionally a
venient intervals throughout the day
should be taken, both a.m. and p.m., i
sights for equal altitudes of the sun, f
taken at short intervals between 8.30
as to have every chance of obtaining
of corresponding sights in the afternoo
meridional altitude of the sun for latit
fill up the spare intervals of time will h
When the ship anchors near obser
can send for the azimuth compass,

[redacted]ainted with the state of the day's work, and can then [redacted]rmine whether it will be proper to advance on the [redacted]wing day.

[redacted]n analysis of the day's work shows, that on the com- [redacted]d base line between observatory and ship, we have, [redacted]t in importance, the triangle formed with Cone Mount; [redacted]ndly, that formed with Double Head; and thirdly, [redacted]e one formed with Red Island; of which last we have [redacted]sured all the angles. From this data, the sides of [redacted]triangles forming the distances between the observatory [redacted]on at White Rock, and Cone Mount, Double Head, [redacted]d Red Island should be *calculated.*

[redacted]bjects of secondary importance, fixed by lines *from* [redacted]ions, forming good triangles with such objects, may [redacted]*projected.* For example, in the diagram, lines from [redacted]d Island and White Rock will fix any object along [redacted]coast between these stations.

[redacted]We will now suppose that the Chief has secured the [redacted]tude and longitude of White rock; true and magnetic [redacted]rings of some remarkable object used in the survey; [redacted]es to all points, bluffs, peaks, and other objects likely [redacted]be useful; together with angles of elevation of the [redacted]cipal mountains; and that the ground round Flat [redacted]nd has been sounded, and the survey complete from [redacted]gged Head up to the ship's anchorage; which we will [redacted]ame to be the first day's work.

[redacted]At daylight on the following morning, ship weighs, and [redacted]s off shore about seven miles (more or less, according [redacted]he depth of water, &c.), then in to five miles, and out [redacted]in; fixing by angles at each alteration of the course,

and carrying a zigzag line of soundings between those limits, along the coast for about ten miles, to position No. 3, where she should anchor by 2 or 3 p.m., and get ready for measuring a base by sound.

Pinnace also proceeds to sound along the coast, making a zigzag line between two and five miles from the shore, returning to the ship by sunset.

The officers in charge of the sounding, on board both ship and pinnace, will frequently be called on to exercise their tact and forethought in the choice of objects to fix their positions by. It may be taken for granted that most of the remarkable objects *on* the coast line, and all outlying rocks and islands, will be fixed by the Chief when he comes along; but it should be remembered, that he may not be able to see anything *within* the coast line, from the view in that direction being interrupted by trees, and therefore hills and other objects remarkable from the sea may be shut out from him altogether. When the ship finds any difficulty in fixing, she should go direct to her arranged next position, and anchor, thus making a good mark for pinnace to fix by.

The Chief, in gig, proceeds first to the point within White Rock, for angles to lay in the coast line by; afterwards take up a station in depth of the bay, between it and Double Head, then at the outer point of Double Head. She would carry a line of soundings along the coast, between each of her stations, and if there be time, run a mile or so off shore occasionally. By the time gig has finished as far as Double Head, the ship will probably be anchored in position No. 33; if so, Chief will take the

: between her and Cone Mount, from Double Head
m; and should there be any rocks extending from
: Mount Point, take an angle to one, for a station.
or more stations between Double Head and Cone
t, according to circumstances, will be necessary.
r will probably be fixed by the objects—Double
l, ship and Cone Mount; but if possible, return
:s should be obtained to them from either Double
l or ship. The Chief should therefore always
avour to take up his stations, for laying in coast line,
emarkable points or rocks. In such cases a little
ewash will be found very useful to mark the stations,
e direction it is particularly wished they should be
from.

n arriving at Cone Point station, gig will show signal
neasuring base by sound. Ship fires three guns as
re, and again angles are taken to objects on each side.
: Double Head is the object on one side, and Pinnacle
nt on the other; take also the angle between Cone
nt and gig's station at the point. From the ship, this
e being so small will be best observed by a reference
oth objects to some well-defined point, forming a con-
rable angle right or left, and taking the difference
reen them: this method is recommended when
suring a side angle with a sextant.

he Chief will, of course, take angles to *all* objects,
a true bearing of some point, before leaving the station,
wind up by bringing a line of soundings off to the
. The assistant on board the ship has obtained all
necessary angles at the time of measuring the base,

and arranged them properly on a sketch of the c
He ought also at each position to obtain true
compass bearings of some important object, and angl
elevation to all the principal peaks.

In the case here illustrated, we will suppose that
Chief and assistant have fixed on Pinnacle Peak
the northern point for angles. To the southward, Do
Head is the object; and as the positions of Double H
and Cone Mount were fixed from our stations of yester
(White Rock, and No. 2 ship), we now have an oppo
nity of checking the first day's work. White Rock is
in sight, or it would, of course, have been used in pre
ence to Double Head.

The survey being complete up to the ship's positi
No. 3, and objects to northward fixed for the morro
work, the ship can be got ready to weigh at daylight.

Next day's operations are carried on in the same mann
Ship anchors in position No. 4, off Pinnacle Point, a
Chief takes up his station for measuring base on the poi
itself. When all the observations have been taken,
reconnoitres the bay to the northward of him, and judgi
from appearances that it will require a close examinatio
he signals to ship, on which ship weighs again and ente
the bay, accompanied by pinnace.

We have now surveyed upwards of twenty miles o
coast from our last observation spot, and as we hav
determined to make a separate plan of the bay on a large
scale, we will bring our coast survey to a close, and obtain
sights for latitude, longitude, &c., at Pinnacle Point station,
and proceed as illustrated under "Harbour Survey."

In reference to the ship's position, No. 4 on the diagram, will be seen that Cone Mount is the southern point of main triangle in that direction; consequently we have heck on the distance between Cone and Pinnacle unts obtained yesterday. On checking the distances ng the coast, by the different bases measured by sound, y are found to agree, and numerous true bearings roborative of each other, have kept the work correct in nuth.

PLOTTING.

To plot this work, mark a spot in a convenient position the south observatory station, and draw a vertical line ough it, for the true meridian. Set off the true bearing es of direction to Red Island station, Double Head, ne Mount, and ship; on which lines fix the positions of se points according to their mean distances. Next, ce Cone Point station by Double Head and Cone unt, and when this station is satisfactorily fixed, lay off ip at No. 3, and Pinnacle Mount, using the mean of the tance obtained from the ship's positions, Nos. 3 and 4. Pinnacle Mount be seen from the point, fix the station ere, as at Cone Point; and from it, the ship at No. 4. s it is often difficult to fix a station on a point, without a le of direction from some position already fixed, the sur- yor ought to provide for it in his progress along the ast, by anticipation. Thus, at observatory station, he uld take an angle to a remarkable rock or object on extreme point of Double Head. At the point of uble Head take some object on the point off Cone

Mount for a station, and should there be several re rocks, take them all.

If stations on the summits of Double Head an Mount were taken up, there would be, generally, a sion for the stations on the outer points.

When the main triangles are plotted from calcu the minor points, and coast line, may be projected.

To test the work, draw the true meridians in p through the two observation spots at White Rock Pinnacle Point; then draw a line through the two stati and take off the course and distance from one to the oth With the observed latitude and longitude calculate th same. They should agree exactly; though, provided th courses or bearings agree, a difference in the distance i not material, as it is nearly certain to be regular through out; and the survey will be graduated, and its scale de termined from the astronomical positions.

Should the coast surveyed run nearly north and south as in the case before us, and the difference of longitud by projection and observation not agree, it may be advi able, in order to keep the work correct in azimuth, to di regard the second longitude by observation; and assumin that projected to be correct, graduate from it, and th difference of latitude by observation. This can only b done when the Chief feels confidence in the correctnes of his true bearings; it is therefore absolutely necessar that he should be exact and expert in taking them. O an irregular coast survey, such as the one here treated o true bearings should be observed from the shore and fro the ship twice a day in each position.

Constructing a Chart.—There are several methods, each which may be more desirable under varying circumstances. In low latitudes a mercator projection may well used in plotting a survey; a more invariably useful one hat of the plane spherical principle, that is with the idians inclined to each other, representing nearly the ural appearance of the earth's surface, and which is ribed, and an example given in the Admiralty Manual, s 58 and 59, which is on board every man-of-war. in the case of an exact piece of triangulation in a plete survey with astronomical and geoditical data, it lotted as on a plane, and reduced for any adoption by ed draughtsmen.

TO FIND THE HEIGHT OF MOUNTAINS.

n surveying work this problem is used not only to rtain the height of a mountain absolutely, but that of station above or below another; and in this way a in of elevation accompanies a triangulation, verified rand then by the actual measurement of the height of one conveniently near the sea, above the main sea l. It is a calculation of great nicety when the accuracy eodesy is attempted, arising from the spheroidal figure he earth, and the varying and subtle curvatures for ction. As a part of such surveying work as we have a describing, it is comparatively simple: observe the e of elevation off and on, and with the known distance eed thus.

For curvature, take one-half of the distance, and sul one-eleventh of the distance for refraction. To this the observed angle of elevation, subtract the true dip, the result will be the true angle of elevation. Then together log. of the distance, tang. of angle of eleva and log. of the number of feet in a mile; the result be the log. of the height in feet.

To find the true dip.—To the constant log. 6·49057 half the log. of the height of the eye in feet, and the will be the log. tang. of the true dip. If the angle of vation be taken on shore with a level, reduce it to mean tide level.

Example.—Mount Etna was seen at 57 miles distan and subtended an angle of 1° 30′ 0″ with the horizon, t height of the eye was 20 feet; required the height of t mountain.

Distance.....	57′		
½.....	28	30″	
¹⁄₁₁	5	11	
Observed angle of elevation	23	19	
	1° 30	0	
	1 53	19	
True dip.....	4	46	
True angle of elevation	1 48	73	

57..... .....1·755875
tan. of elev. .....8·499300
60756 .....3·783576
Height = 10934 ft. } .....4·038751
Const. log. .....6·49057
½ log. 20.....0·65051
tan. true dip = 4′ 46″ .. 7·14108

To ascertain the Height of a Station above or below another, proceed thus:—To constant log. 7·9933, add the

of distance, take out natural number, which, divided
2, gives curvature. $\frac{1}{12}$th of first natural number is
action; always take the difference, adding to an eleva-
, subtracting to a depression, then take out the log
gent (sine small arcs) of corrected elevation or depres-
, and add to it the log of distance, which gives the
erence of height.

Each height as it is worked should be numbered, so that
uld any question arise as to the accuracy of the work,
an be easily looked up.

After ascertaining in this way the height of a mountain
m a ship at sea, and an opportunity offering for visiting
summit, a verification can usefully be obtained by
arometrical Measurement"; an aneroid compared with
ndard and carried to the top as spoken of in "River
rvey," would inform you of the amount of confidence
be placed on this method, when it may be the only
ailable means on future occasions.

Having now pointed out and endeavoured to explain
w much valuable work of a surveying character can be
complished by means of the instruments found on board
ery man-of-war, it is desired to impress upon every young
ficer, that he should be able to perform the same; and
rtainly no navigating officer can be held to know his
rk thoroughly, who is unequal to this amount of survey-
g: its application is continually of the greatest value in
s work of navigation and pilotage, it facilitates the
certaining of a ship's true position, of the requisition of

and explanations, called "Sailing Direc
greatly to the value of a piece of work
little practice, briefer and less formal m
saving variations will develope themselv
a charm to the work, and will often lea
acquirement of a knowledge of exact s
has not been pretended to treat of here

PART III.

TABLES.

TABLE I.*

For ascertaining the Strength of Hempen Cables

Size in Inches.	No. of Yarns.	Weight in lbs. of 100 Fathoms.	Breaking Strain in Tons.			
			Maximum.	Minimum.	Mean.	Weak
26	3528	14112	22'2	105'9	111'6	
25½	3393	13572	17'3	101'9	107'3	
†25	3267	13068	13'0	98'0	103'2	
24½	3122	12488	14'4	94'4	101'3	
24	3006	12024	15'7	91'0	101.9	
23½	2880	11520	17'0	87.6	101'3	
23	2763	11052	18'3	84'2	100'7	
†22½	2646	10584	19'3	81'0	100'2	
22	2529	10116	11'4	77·9	95'0	
21½	2412	9648	103'5	74'9	90'1	
21	2304	9216	95'8	72'0	85'3	
†20½	2196	8784	88'3	69'2	80'6	
20	2088	8352	81'0	66'3	76'1	
19½	1980	7920	76'7	62'1	72'3	
19	1881	7524	72'6	57'9	66'6	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE II.

)R ASCERTAINING THE STRENGTH OF CHAIN CABLES.

in ys.	Testing Strain. in Tons.	Weight in lbs. of 100 Fathoms.	Breaking Strain in Tons.			
			Maximum.	Minimum.	Mean.	Weakest. ‡
	91⅛	27216	130·3	121·8	125·9	107·4
	81½	24276	116·2	108·6	112·3	95·8
	72	21504	103·0	96·25	99·5	—
	63½	18900	99·0	88·0	92·8	—
	55⅛	16464	85.25	65·0	74·1	65·0
	47½	14196	75·0	59·5	66·5	56·0
	40½	12096	65·5	54·5	59.5	—
	34	10164	53·6	44·4	48·5	40·1
	28½	8400	42·8	35·3	38·5	33·1
	22⅝	6804	33·0	27·0	29·5	26·0
	18	5376	27·25	22·0	24·3	21·2
	13⅝	4116	22·5	20·3	21·1	16·2
	10⅛	3024	15·0	12·5	13·5	11·9
⅛	8½	2541	12·3	10·8	11·4	10·0
	7	2100	9·87	9·37	9.5	8·2
⅛	5⅛	1701	—	—	—	—
	4½	1344	6·3	5·9	6·0	5·3

f actual experiments, and the intermediate lines those derived from calcu-
riments, and may be serviceable where risk is apprehended, and great

TABLE III.

FOR ASCERTAINING THE STRENGTH OF HAWSER-LAID ROPE.

Size.	No. of Yarns.	Weight in lbs. of 100 Fathoms.	Strain in Tons.		
			Maximum.	Minimum.	Mean.
† 12	1173	2940	45·5	35·0	40·0
11½	1077	..	41·7	32·0	36·7
11	987	..	38·2	29·3	33·6
10½	900	..	34·9	26·7	30·7
10	816	2136	31·7	24·2	27·9
9½	738	..	28·6	21·8	25·2
9	660	1712	25·7	19·6	22·6
8½	591	..	23·0	17·5	20·2
8	522	1379	20·4	15·5	18·0
7½	459	..	18·0	13·6	15·8
7	399	..	15·8	11·8	13·8
6½	345	..	13·7	10·2	12·0
† 6	294	834	11·7	8·7	10·2
5½	249	712	9·8	7·3	8·7
5	204	..	8·2	6·1	7·2
4½	168	413	6·7	5·0	5·9
4	132	..	5·3	4·0	4·7
3½	102	..	4·1	3·2	3·7
3	75	203	3·1	2·4	2·8
2½	54	..	2·2	1·8	2·1
2	33	..	1·5	1·3	1·4
† 1¾	27	..	1·28	1·13	1·23
† 1½	21	..	·90	·86	·88
† 1¼	15	..	·60	·53	·56
† 1	12	..	·58	·46	·51
† ¾	9	..	·51	·42	·46
† ½	6	..	·28	·28	·28

† The lines thus marked contain the results of actual experiments.

TABLE IV.

ASCERTAINING THE STRENGTH OF ROUND-LINKED CRANE CHAIN.

Diam.	Weight in lbs. of 100 Fathoms.	Strain in Tons.			
		Maximum.	Minimum.	Mean.	Testing Strength.
† 2⅝	15569	75·0	68·0	73·0	31·6
2½	..	64·0	58·2	62·3	27·0
2 7/16	..	59·0	53·8	67·4	24·7
2⅜	..	54·2	49·6	52·8	22·6
2 5/16	..	49·7	45·5	81·4	20·6
2¼	..	45·3	41·7	44·1	18·8
2 3/16	..	41·2	38·0	40·1	17·0
2⅛	7481	37·3	34·5	36·3	15·3
2 1/16	..	33·6	31·2	32·7	13·6
2	6490	30·1	28·1	29·3	12·0
1 15/16	5600	26·8	25·2	26·1	10·5
1⅞	4500	23·7	22·5	23·1	9·1
† 1 13/16	4000	20·9	20·0	20·4	7·9
1¾	3449	17·8	16·6	17·3	6·8
1 11/16	2900	14·9	13·5	14·6	5·6
1⅝	2538	12·3	10·8	12·0	4·6
1 9/16	2001	10·0	8·7	9·7	3·8
1½	1583	7·9	6·9	7·7	3·0
1 7/16	1060	6·0	5·2	5·9	2·3
1⅜	827	4·4	3·8	4·3	1·6
1 5/16	581	3·0	2·7	3·0	1·1
1¼	392	1·9	1·7	1·9	·75
1 3/16	..	1·1	·97	1·0	·42

[illegible] the intermediate lines those derived from calculation.

TABLE V.

SHOWING THE STRENGTH OF WIRE-ROPE.

Circumference.	Weight of one fathom	Breakg. Strain.
Inches.	lbs.	Tons.
1	1	2
1¼	1½	3
1½	2	4
1¾	2½	5
1⅞	3	6
2	3½	7
2¼	4	8
2½	4½	9
2⅝	5	10
2¾	5½	11
2⅞	6	12
3	6½	13
3¼	7	14
3½	7½	15
3½	8	16
3¾	8½	17
3⅞	9	18
4	10	20
4¼	11	22
4½	12	24
4⅝	13	26
5	14	28
5½	18	33
6	22	38

TABLE VI.*

SHOWING THE STRENGTH O

Single Blocks:	Capacity for Strain.
Inches.	Tons.
6	1⅛
7	1¼
8	1½
9	1⅝
10	2⅛
11	3½
12	4½
13	5½
14	5⅞
15	6½
16	7⅞
17	8½
18	9½
19	10½
20	11⅝
21	12½
22	13⅝
23	14½
24	16½
25	18
26	20½
27	22
28	24

A common t
reeves a rope
the length of
A clump block
length.
A thin block, or
A fiddle block,

The stropping of
block is one-
size of the blo
instance, the
of a 6-inch bl
2-inch rope: o
block 5-inch ro

Double blocks
double strop
threefold block
a double strop
rope, or a sm
venter strop in
to the double o

Although a sing
has the same
as a double or
block, it must b
ferred that a sin
will sustain a
strain with
block. A treb
is in fact thre
in one; and th
being distribu
tween them r
capable of st
three times th
of a single bloc
responding size

* Bushell's "Rigger's Guide."
(A valuable little book.)

TABLE VII.*

NG THE MEAN STRENGTH AND ELASTICITY OF CERTAIN MATERIALS.

TERIALS.	C.	S.	E.	M.
VOODS.	lbs.			
.....	17000	2026	6580000	4988000
.....	11500	1560	5417000	4457000
nristiana	11000	1550	6350000	5378000
emel	11000	1730	6420000	6268000
.....	5780	1030	2803000	3007000
v England ...	12000	1100	5967000	6249000
ga	12600	1130	5314000	4080000
ır Forest.....	12000	1140	3400000	2797000
ıy	8000			
spars	12000	1470	5830000	5789000
glish { from	9000	1200	3490000	2872000
glish { to...	15000	2260	7000000	4702000
lriatic	14000	1380	3880000	2257000
rican	14400	2000	9500000	5583000
nadian.....	12000	1760	8950000	5674000
....	14000	2200	6760000	6488000
:ch	10500	1630	5000000	4364000
d	10000	1340	7360000	6423000
....	15000	2460	9660000	7417000
RON.				
t ... { from	16300	8100	69120000	5530000 §
t ... { to ...	36000			
lleable	60000	9000	91440000	6770000 §
re	80000			

ı the "Mechanics' Pocket Guide." † Of English growth.
East Indies. § Mean of English and Foreign.
The application of this Table a. the end of Art. 536.

TABLE VIII.

Specific Gravity and Weight of Materials.

Species.	Specific Gravity.	Weight of 1 cub. ft.	Weight of 1 cub. in.	Species.	Specific Gravity.	Weight of 1 cub. ft.	Weight of 1 cub. in.
		lbs.	oz.			lbs.	oz.
Water, distilled	1'000	62'5	0'579	Cork	0'240	15'0	0'139
—— from the Baltic	1'015	63'75		Deal, Christiana	0,681	42'5	0'394
—— Mediterranean	1'029	64'38		—— Memel	0'390	36'9	0'341
—— Dead Sea	1'240	77'5		Elm and Larch	0'540	33.8	0'313
Brass, cast	8'396	524'8	4'859	Fir, New England	0'550	34'4	0'318
Copper, cast	8'788	549'3	5'086	—— Riga and Maple	0'750	46.9	0'434
—— sheet	8.915	557'2	5'159	—— Mar Forest	0'700	43'8	0'405
Gold, pure, hammered	19'362	1210'1	11'205	Lignum Vitæ	1'333	83.3	0'771
—— standard	17'647	1102'9	10'213	Mahogany	0'637	39.8	0'369
Gun metal	8'784	549'0	5'083	Norway Spars	0'580	36'3	0'336
Iron, wrought	7'786	486'6	4'506	Oak, English	0'900	56.3	0'521
—— cast	11'352	709'5	6'569	—— African	0'980	61'3	0'567
Lead, cast	11'352	709'5	6'569	—— Adriatic	0'990	61'9	0'573
Mercury, fluid	13'568	848'0	7'852	Pine, Pitch, and Red	0'660	41'3	0'382
Platinum, pure, hammered	20'336	1271'0	11'767	Poon and Hazel	0'600	37.5	0'347
Silver, pure, hammered	10'511	656'9	6'083	Teak and Plum Tree	0'750	46.9	0'434
—— standard	10'534	658'4	6'096	* Atmospheric Air	1'000	0'075	0'0007
Steel, tempered	7'818	488'6	4'524	Hydrogen Gas	0'069	0'006	0'0001
Tin, cast	7'291	455'7	4'244	Oxygen Gas	1'111	0'090	0'0008
Zinc, cast	7'190	449'4	4'161	Alcohol, absolute	0'797	49'8	0'461
Coal, mean of sorts	1'270	79'4	0'735	highly rectified	0'829	51'8	0'480
Granite ditto	2'698	168'6	1'561	Beer, mean of sorts	1'028	64'3	0'595
Limestone, ditto	2'945	184'1	1'278	Whale Oil	0'923	57'7	0'534
Marble ditto	2'720	170'0	1'574	Olive Oil	0'915	57'2	0'530
Ash, and Dantzic Oak	0'760	47'5	0'440	Gunpowder, shaken	0'912	56'9	0'527

TABLE IX.*

THE POSITIONS OF THE MASTS, SAILS, &c., OF SHIPS AND BRIGS.

Mast and Gear.	Known Quantities, etc,	Proportions in Terms of known Quantities.	
		Frigate.	Brig.
e the middle of of the waterline, fore part of r part of stern-	Length of water-line .. ×	·37	·331
t ditto	Length of water-line .. ×	·062	·147
ft ditto	Length of water-line .. ×	·341	—
ast	In 12 feet	2-in.	3-in.
nast	In 12 feet	6-in.	10-in.
mast	In 12 feet	10-in.	—
it	In 12 feet	63-in.	51-in.
w water-line	Breadth .. .. ×	·3	·245
w water-line	Breadth .. .. ×	·25	·2
ow water-line ..	Breadth .. .. ×	·06	—
d from fore part of	Breadth .. .. ×	·46	·5
t before the middle r-line	Length of water-line .. ×	·059	·026
re of effort	Breadth .. .. ×	1·56	1·5
.. ..	Area of load water section ×	3·14	3·74
il	Area of load water section ×	160·0	175·8
draught of water, ...	Length of water-line .. ×	·005	·035
ment of sails before to the moment aft	Fore to the after as 1 to	·69	·83
k	..... Feet	113·75	
ne	..... Feet	31·83	

* Tables IX. to XV. are from Fincham.

TABLE X.

SHOWING THE PROPORTIONS FOR THE LENGTHS OF MASTS YARDS OF SHIPS AND BRIGS.

Species of Mast and Gear.	Known Quantities.		Proportio Terms of Quantit Frigate.
Main-mast hounded *	Breadth	×	1·94
---- -- headed	Hounded length	×	·1933
Fore-mast hounded	Main-mast hounded ..	×	·91
---- ---- headed	Hounded length	×	·1933
Mizen-mast hounded	Main-mast hounded ..	×	·773
---------- headed	Hounded length	×	·156
Main-top-mast hounded..	Breadth	×	1·15
— ------- headed	Hounded length	×	·156
Fore-top-mast hounded..	Main-top-mast hounded	×	·91
---- ---------- headed	Hounded length	×	1·56
Mizen-top-mast hounded	Main-top-mast hounded	×	·77
---- ---- headed	Hounded length	×	·156
Main-top-gallant-mast hounded ..	Breadth	×	·61
---- ---------- pole	Hounded length	×	·75
Fore-top-gallant-mast hounded ..	Main-top-gallant-mast hounded..	×	·9
---------- pole	Hounded length	×	·75
Mizen-top-gallant-mast hounded	Main-top-gallant-mast hounded	×	·75
---- ---------- pole.. ..	Hounded length	×	·75
Bowsprit	Fore-mast hounded ..	×	·8
Jib-boom	Bowsprit	×	·733
Flying Jib-boom	Jib-boom	×	1·1
Main-yard..	Length	×	·553
Main-topsail-yard	Main yard..	×	·74
Main-top-gallant-yard	Main-topsail-yard for ships Main-yard for brigs	×	·61
Main-royal-yard	Main-top-gallant yard ..	×	·7
Fore-yard	Main-yard..	×	·873
Fore-topsail-yard	Main-top-sail-yard	×	·879
Fore-top-gallant-yard	Main-top-gallant-yard ..	×	·88
Fore-royal-yard	Fore-top-gallant-yard for ships Main-royal-yard for brigs	×	·7
Cross-jack-yard	Main-topsail-yard	×	1.0
Mizen-topsail-yard	Ditto ditto	×	·665
Mizen top-gallant-yard	Main-top-gallant-yard ..	×	·753
Mizen-royal-yard	Mizen-top-gallant-yard ..	×	·7
Spritsail-yard	Fore-topsail-yard	×	1·0
Driver-boom (brig's main boom) ..	Length	×	·395
Gaff	Driver-boom	×	·724
Trysail-gaff	Gaff	×	·3
Main-trysail-gaff (brig's fore) ..	Ditto	×	·6
Swing boom	Main-yard..	×	·6

* The "hounding" is the whole length of the mast, exclusive of the head.

TABLE XI.

ATE THE LARGEST, OR GIVEN DIAMETERS* OF THE SPARS OF SHIPS AND BRIGS.

'ECIES.	PROPORTIONATE DIAMETER.
nainmasts	One inch for every three feet of the length.
ts	Two-thirds of the diameter of the mainmast.
.....	One inch to every three feet in length.
t-masts	One inch to every three feet in length.
.....	The same diameter as the mainmast.
nain-yards	Seven-tenths of an inch to every three feet in length.
ross-jack, and yards	Five-eighths of an inch to every three feet in length.
t-yards	Six-tenths of an inch to every three feet in length.
s	Three-fifths of an inch to every three feet in length.
ail-yards and ail booms.....	One inch to every five feet in length.
.....	Seven-eighths of an inch to every three feet in length.
booms.....	One inch to every six feet in length.
ms	The same diameter as the main-top-sail-yard.
. .....	Two-thirds of an inch to every three feet in length.

' *masts*, this is at the partners or decks; in masts of three-deck ships, eter is at the middle deck; and in all the other ships, at the upper ging deck.
and *top-gallant-masts*, the given diameter is at the caps, or at the ast below, to which they are affixed. In *bowsprit*, it is at the bed; of cutters, where it is generally one-third from the inner end. In the slings or middle; in *jib-booms*, at the bowsprit-cap, or at one-inner end; in *driver or main booms*, at one-third from the after end, rail or sheet; in *studding-sail booms, top and top-gallant*, at each end, between which they are parallel; and in *swing or lower ooms*, at one-third from the outer end.

TABLE XII.

THE PROPORTION WHICH EACH PART OF A MAST OR YARD BEARS TO THE GIVEN DIAMETER.

Species	Heel.	Quarters. 1st.	Quarters. 2nd.	Quarters. 3rd.	Head. Lower Part.	Head. Upper Part.	Pole, Yardarms, or Ends.
Lower masts	2	1	11/12	5/6	1/2	3/4	..
Topmast	..	1	11/12	5/6	1/2	3/4	..
Top-gallant-masts	..	1	11/12	5/6	1/2	..	1/2
Yards	..	1	1/2	3/4	..	..	1/2
Bowsprit	2	1	11/12	3/4	..	..	1/2
Jib-boom	..	1	11/12	3/4	..	..	1/2
Driver-boom	..	1	11/12	3/4	..	..	1/2

Proportional Dimensions of Tops, Caps, and Cross-trees.

Species.	Length.	Breadth or Width.	Depth or Thickness.
Tops	$\frac{3}{4}$ the breadth at fore cross-tree	At fore cross-tree, $\frac{1}{8}$ the whole length of the topmast. After part $\frac{9}{16}$ the length of the topmast.	
Trestle-trees	Length of the top fore-and-aft, or $\frac{5}{6}$ the whole length of the topmast	Two-thirds of the depth	$\frac{3}{4}$ of an inch to every foot in length.
Fore cross-tree ..	$\frac{49}{64}$ of the breadth of the top at the fore part of the square hole	Same as that of the trestle-trees	$\frac{3}{4}$ of their breadth.
After cross-tree ..	$\frac{33}{64}$ of the top at the after part		
Lower cap	Wood left before the round hole is $\frac{1}{3}$ the depth of the cap. Wood abaft the square hole the depth of the cap	Two diameters of the topmast, and one inch	One inch less than the diameter of the topmast.
Bowsprit cap ..	Five diameters of the jib-boom	Twice the diameter of jib-boom	$\frac{5}{8}$ diameter of jib-boom.
Topmast cap.. ..	In the same proportion to the top-gallant mast, as lower cap is to topmast.		
Trestle-trees	Seven-twelfths of the lower trestle-trees.		
Cross-trees	After horn, $\frac{7}{8}$ of the lower after cross-tree. Foremost horn, $\frac{7}{8}$ of the after one.	The breadth of the trestle-trees	$\frac{1}{2}$ of the breadth.

TABLE XIV.

Proportions for the Spars of Schooners and Cutters.

	Length	Breadth.		Length	Breadth.
Schooner, Three Masts	78·7 ft.	21·6 ft.	Bermuda Sch.	95·0 ft.	24·7 ft.
Ditto, Brig forward	110·6 „	25·6 „	Cutter, Yacht	63·1 „	19·2 „
Ditto, Common	99·0 „	24·0 „	Rev. Cruiser	63·7 „	22·1 „

Main mast hounded		Breadth	
headed		Hounded length	
Fore mast hounded		Main mast hounded	
headed		Hounded length	
Mizen mast hounded		Main mast hounded	
headed		Hounded length	
Main top mast hounded		Breadth	
pole		Hounded length	
Fore top mast hounded		Main top mast hounded	
headed		Hounded length	
Mizen top mast hounded		Main top mast hounded	
pole		Hounded length	
Fore top gallant mast hounded		Breadth	
pole		Hounded length	
Bowsprit		Fore mast, or shears	

Proportions in Terms of known Quantities.

Three Masts.	Schooners. Brig forward.	Common.	Bermuda.	Cutters. Yacht.	Revenue Cruiser.
2·78	3·11	2·61	2·75	3·34	2·63
·1	·13	·12	·13	·2	·20
·95	·734	·92	·97	—	—
·1	·193	·12	·13	—	—
·74	—	—	—	—	—
1	—	—	—	—	—
·25	1·1	·83	1·0	2·305	1·77
·11	·43	·5	·5	·96	·3
·92	1·08	1·0	·9	—	—
·11	·156	·5	·5	—	—
·9	—	—	—	—	—
·74	—	—	—	—	—
	·77	—	—	—	—
	·55	—	—	—	—
	—	—	—	—	·8

MASTING PROPORTIONS.

Mizen or Driver-boom	Length .. .. ×	·39	—	—	—	—	—
Jib-boom	Bowsprit .. .. .. ×	·97	1·21	·87	1·3	—	—
Flying jib-boom before jib-boom	Jib-boom .. .. ×	·4	·4	—	—	—	..
Swinging-boom	Fore-yard .. . .. ×	·5	·68	—	—	—	—
Ringtail-boom	Length .. .. ×	·21	—	—	—	·562	·552
Square-sail-boom	Ditto .. .. ×	·22	—	·4	·37	·464	·51
Gaff-topsail-yard	Gaff .. .. ×	—	—	—	—	·25	·25
		abaft.	abaft			before.	before.
Main-mast from the middle	Length of water-line .. ×	·033	·11	·046	·108	·112	·13
Fore-mast before ditto	Ditto ditto .. .. ×	·295	·3	·338	.279	—	—
Mizen-mast abaft ditto	Ditto ditto .. .. ×	·366	—	—	—	—	—
Main-mast to rake	In 12 feet	27 in.	33 in.	24 in.	24 in.	12 in.	14½ in.
Fore-mast ditto	Ditto	24 ,,	28 ,,	15 ,,	16 ,,	—	—
Mizen-mast ditto	Ditto	30 ,,	—	—	—	—	—
Bowsprit to stive	Ditto	22 ,,	36 ,,	34 ,,	24 ,,	7½ ,,	18 ,,
Main-mast below load-water-line	Breadth .. .. ×	·227	·26	·26	·31	·31	·272
Fore-mast ditto ditto	.. .. ×	·17	·22	·22	·27	—	—
Mizen-mast ditto ditto	.. .. ×	·232	—	—	—	—	—
						abaft.	abaft.
Centre of effort from the middle of the length of the water-line	Length on water-line .. ×	·0065	·0163	·02	·023	0·395	·0167
Height of the centre of effort above the load-water-line	Breadth .. .. ×	1·539	1·72	1·5	1·5	1·5	1·27
Area of sails	Area of load-water section ×	4·944	4·59	3·63	3·54	3·2	3·56
Moment of sails	Breadth of load-water section ×	164.4	204·0	138·0	128·6	89·1	97·7
Bowsprit housed from the fore part of the stern	Breadth	·32	·35	·46	·448	·62	·65
Difference of draught of water, excess aft	.. ..	36 in.	24 in.	12 in.	24 in.	54 in.	65 in.

TABLE XV.

Proportionate Dimensions (Maximum), for Masting Boats.

Length.....32 feet.
Breadth ..... 8·5 feet.

Species of Mast.	Known Quantities.	Fig. 1	Fig. 2	Fig. 3.	Fig. 4.	Fig. 5	Fig. 6.	Fig. 7.	Fig. 8.
Main-mast hounded ..	Breadth of boat .. .. ×	3.1	2·46	2·15	1·76	2·7		2·7	
..... pole	Main-mast hounded .. ×	·15							
Fore-mast hounded ..	Main-mast, figs. 1, 2, 3, 4, 5, 7, Breadth, figs. 6 and 8 .. ×	·92	·9	·8	·98	·9	3·08	·9	3·08
..... pole	Fore-mast hounded .. ×	·15							
Mizen-mast	Main-mast, figs. 1, 2, 3, 4, 5, 7, Fore-mast, figs. 6 and 8 .. ×		·54	·43	·67	·6	·6	·6	·6
Main-yard	Length of boat .. .. ×			·83	1·06	·4			
Fore-yard	Main-yard, figs. 1, 2, 3, 4, 5, 7, Length, figs. 6 and 8 .. ×			·95	·9	·9	·4		·5
Mizen-yard	Main-yard, figs. 1, 2, 3, 4, 5, 7, Fore-yard, figs. 6 and 8 ×			·56	·53	·7	·87		·76
Main-sprit, or slide ..	Main-mast .. .. ×		1·0					·9	
	Fore-mast .. .. ×		1·0					·9	

Main-gaff	**Length of boat**	×	·26							
Fore-gaff	**Main-gaff**	×	·92							
Main-boom	Length of boat	×	·6							
Boomkin	Ditto ditto	×				·25	·43	·45		·45
Outrigger	Ditto ditto	×		·34	·380	·343	·4	·45	·43	·44
Bowsprit	Ditto ditto	×	·43	·43			·44	·42	·44	
			before.		abaft.	before.	before.		before.	
Main-mast from themiddle	Ditto ditto	×	·031	·056	·037	·018	·066	·359	·066	
Fore-mast before ditto	Ditto ditto	×	·343	·343	·312	·37	·33		·33	·359
						forward				
Fore-mast to rake ..	Aft in a foot		2 in.	·1		3½ in.	·1	2 in.	·1	1 in.
Main-mast ditto ..	Ditto ditto		4 ,,	·2			·2		·2	
Mizen-mast ditto ..	As the transom									
						Feet in length.				
Diameter of masts ..	One inch to		4'5	4'0	3'6	3'6	4'4	4'4	4'4	4'4
.....yards ..	Ditto				5'0	5'0	5'0	5'0		5'0
.....booms ..	Ditto		5'5							
.....gaffs ..	Ditto		3'2							
.....bowsprits ..	Ditto		2'5	2'5			2'5	2'5	2'5	2'5
.....outriggers	Ditto			3'0	3'0	3'0	3'0	3'0	3'0	3'0
.....sprits ..	Ditto								9'0	
.....slides ..	Ditto			5'4						
.....boomkins ..	Ditto				2'4	2'4				

TABLE XVI.

Number of Hempen Cables and Hawsers on Board.

Line-of-battle Ship.	Iron Clad "Prince Consort" Class.	Corvette—"Volage" Class.	Corvette—"Dido" Class.
Stream Cable 14½ inch.	Stream Cable 14½ inch.	Stream Cable 13½ inch.	
Cablets.	Cablets.	Cablets.	
3 .....9 inch	1 .....12 inch	1 .....9 inch.	1.....8 inch.
1 .....7½ ,,	2 ..... 9 ,,	1.....7 ,,	1.....7 ,,
1 .....6 ,,	1 ..... 8 ,,	1.....6 ,,	1..... 6½ ,,
1 .....4½ ,,	1 ..... 7½ ,,	1.....5 ,,	1.....5½ ,,
	1 ..... 6 ,,	1.....4 ,,	1.....5 ,,
	1 ..... 4½ ,,		1.....4½ ,,
			1.....3½ ,,

HEMP CABLES AND HAWSERS.

This Table is intended to give a general idea of the number and size of hawsers supplied to different ships, and as part answer to Question 122; one commonly given at a Seamanship Examination, the correct solution however can be best obtained on board.

TABLE XVII.

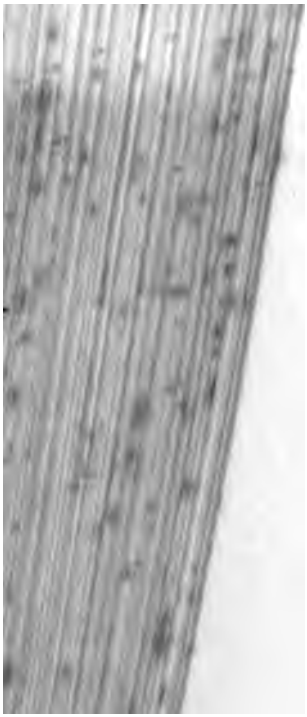
I.—TIME.

60 Seconds	1 minute.
60 Minutes	1 hour.
24 Hours	1 mean solar day.
7 Days	1 week.
28 Days	1 lunar month.
12 Calendar months (365 days)	1 civil year.
365 Days, 5 hours, 48 minutes, 47·6352 seconds...	1 solar year.

Note.—As the ordinary civil year consists of but 365 days, instead of nearly 365¼ days, an additional day is added to the month of February every fourth, or leap-year, which is a compensation that originated with Julius Cæsar. Leap-year is found by dividing the year, or the two first numbers of the year, by 4; the remainder shows the number of years that it is after leap-year, or leap-year, simply, if without a remainder. As, however, the astronomical year is not quite 365¼ days, the intercalation is too great to the amount of 3 days, 2½ hours, in 400 years; and to correct this error, it was provided by Pope Gregory XIII., in 1582, that the first year of every century should not be considered leap-year, as it would be in the Julian calendar, unless the two *first* numbers of the year are divisible by 4. Thus, 1600 was an ordinary year, and so will be the year 1900; but A.D. 2000 will be a leap-year. By this reduction the error is contracted to an excess of one day in 3546 years. The Gregorian, or new style, was not adopted in England until 1751, when 11 days were omitted to effect the requisite reformation in the calendar. The Russians still adhere to the old style.

II.—MONEY.

Farthings	1 penny, *d.* (*denarius*).
Pence	1 shilling, *s.* (*solidus*).



In estin
24 parts,
those parts
fine is pure
est degree s
of alloy. T
2 carats, or o
the coin hard
are coined 46
Standard sil
silver, and 3 pa
2 dwts. of pure
66 shillings.
From a lb. avo
A sovereign pa
dwts. $2\frac{3}{4}$ gr., for g
full weight, in cons
coins are not a leg
more than 12d.

.—A great circle on the earth's surface, which is about 24,869
.n circumference, produces a degree 69·08 miles in length;
: sixtieth part of this constitutes a geographical or nautical
hich is thus about 1·15 of a land mile. The length of a
of longitude, on a parallel of latitude, is found by subtracting
. secant of the latitude from the log. of 60′.

4 Minutes of time = 1 degree of longitude.
15 Degrees = 1 hour.

IV.—WEIGHTS.

TROY.

24	Grains	1 pennyweight.
20	Dwts.	1 ounce.
12	Oz.	1 pound.

l for the precious metals, and in philosophical experiments.
ionds and other precious stones are weighed by carats of 3½
151½ carats are equal to an ounce Troy.

.—By Act of Parliament (5 Geo. IV., c. 74), it was enjoined
: standard of *weight* for the kindom should henceforward be
rial pound Troy of 5760 grains; and that, in case the stand-
uld be lost or injured, it might be recovered from the know-
the fact, that a cubic inch of distilled water, at a temperature
Fahrenheit, and when the barometer is 30 in., weighs 252·458
: grains.

AVOIRDUPOIS.

27·34375	Troy grains	1 dram.
16	Drs.	1 ounce.
16	Oz.	1 pound.
14	Lbs.	1 stone.
28	Lbs.	1 quarter.
4	Qrs.	1 hundredweight.
20	Cwt.	1 ton.

Used for all ordinary goods.

—By the before-mentioned Act it is provided that the lb.
pois shall consist of 7000 grains Troy.

WEIGHTS AND MEASURES.

APOTHECARIES.

20 Grains	1 scruple.
3 Sc.	1 drachm.
8 Drs.	1 ounce.
12 Oz.	1 pound.

By this weight apoth[illegible]ompound their medicines, but dru[illegible] are bought and sold by [illegible]ois weight.

Note.—The gr., oz., an[illegible]re the same as in Troy weight.

480 Minims, or d[illegible]	= 1 fluid ounce
20 Ounces = 1 [illegible]	
8 Pints = 1 [illegible]	
8750 Grains of distilled wa[illegible]er	= 1 imperial pint.
437·5 Ditto ditto	= 1 imperial fluid ounce.

V.—MEASURES.

WINE MEASURE.

4 Gills	1 pint.
2 Pts.	1 quart.
4 Qts.	1 gallon.
10 Galls.	1 anker.
18 Galls.	1 rundlet.
42 Galls.	1 tierce.
63 Galls.	1 hogshead.
84 Galls.	1 puncheon.
126 Galls.	1 pipe.
252 Galls.	1 tun.

ALE MEASURE.

2 [illegible]	1 pint.
2 Pts.	1 quart.
4 Qts.	1 gallon.
[illegible] Galls.	1 firkin.
[illegible] Galls.	1 kilderkin.
[illegible] Galls.	1 barrel.
[illegible] Galls.	1 hogshead.

72	Galls.	1 puncheon.
108	Galls.	1 butt.

Note.—In the above measures the imperial gallon, containing 277·2738 cubic inches, is designated. The old ale gallon contained 282 cubic inches, and the old wine gallon 231 cubic inches; hence—

Old ale gallon × 1·01704 }
Old wine gallon × 0·83311 } = imperial gallon.

By the Act before cited, the imperial gallon was made the standard *capacity* for both dry and wet goods, and was described as containing 10 lbs. avoirdupois of distilled water, weighed in air, at a temperature of 62° Fahrenheit, with the barometer at 30 inches.

Dry Measure.

2	Imperial gallons	1 peck.
4	Pecks	1 bushel.
8	Bushels	1 quarter.
32	Bushels	1 chaldron.
40	Bushels	1 wey, or load.
8	Bushels	1 last.

Note.—The Winchester bushel contained 2150·42 cubic inches, and the imperial bushel contains 2218·192 cubic inches; hence, Winchester bushel × 0·969447 = imperial bushel.

Measure of Length.

12	Lines	1 inch.
12	Inches	1 foot.
3	Feet	1 yard.
5½	Yards	1 pole (rod, or perch.
40	Poles	1 furlong.
8	Furlongs (1760 yards)	1 mile.
2240	Yards	1 Irish mile.
14	English miles	11 Irish miles.
6076	Feet	1 geog. or nautical mile.
3	Miles	1 league.

Note.—The imperial yard is the standard of *length*. This yard is divided into 3 feet, and each foot into 12 inches; and its length is

fixed by comparing it with that of a pendulum, vibrating seconds, *in vacuo*, in the latitude of London, at the level of the sea, the length of which is 39·13929 inches (or thirty-sixths) of this yard. The yard may be otherwise defined as the length of a pendulum which oscillates, *in vacuo*, in the latitude of London, at the level of the sea, 90088 times in a a mean solar day.

Measure of Surface, or Squace Measure.

144	Square inches	1 square foot,
9	Square feet	1 square yard.
30¼	Square yards	1 square pole.
40	Square poles	1 square rood.
4	Roods (4840 square yards)	1 statute acre.
640	Acres	1 square mile.
6084	Square yards	1 Scotch acre.
7840	Square yards	1 Irish, or plantation acre.
113·0972	Square inches	1 circular foot.
183·346	Circular inches	1 square foot.

Note.—A circular foot is a circle whose diameter is one foot.

Superficial Measure for Land.

62·7264	Square inches	1 square link.
10000	Square links	1 square chain.
10	Square chains	1 acre.

Measure of Solidity, or Cubic Measure.

1728	Cubic inches	1 cubic foot.
2200	Cylindrical inches, nearly	
3300	Spherical inches, ,,	
6000	Conical inches ,,	
27	Cubic feet	1 cubic yard.
1357·17	Cubic inches	1 cylindric foot.
904·78	Cubic inches	1 spherical foot.
459·39	Cubic inches	1 conical foot.

Note.—A cubic inch is a cube 1 inch square; a cylindric inch is a cylinder 1 inch long, and 1 inch in diameter; a spherical inch is a

inch in diameter; and a conical inch is a cone 1 inch in and 1 inch in diameter at the base.

VI.—MISCELLANEOUS.

ıches	1	palm.
ıches	1	hand.
ıches	1	span.
ıches	1	cubit.
eet	1	pace.
eet	1	fathom.
ıthoms (strictly 126½ fathoms)	1	cable's length.
ıbles' length	1	nautical mile.
quare feet of inch boards	1	load.
ıbic feet of round timber ıbic feet of hewn timber	1	ton, or load.
llets, or ıbic feet, or wt.	1	cord of wood.
ıbic feet	1	stack of wood.
bs., or . × 6 ft. × 2 ft.	1	fathom of wood.
bs.	1	bushel of coals.
wt.	1	sack of coals.
ıcks (42 in. by 30 in.)	1	ton of coals.
ıbic feet	1	ton of shipping.
eals or nails	1	hundred.
one of new hay one of old hay	1	cubic yard.
s. of straw s. of old hay	1	truss.
usses	1	load.
s. of meat or fish	1	stone.
s. of butter	1	firkin.
bs. of hops, Kentish bs. of hops, Surrey and Sussex	1	pocket.

236 Gallons sweet oil 252 Gallons fish	1 ton.
24 Sheets of paper	1 quire.
20 Quires	1 ream.

VII.—WATER AND PROVISIONS.

Water.

1 Ton = 35·84 cubic feet—224 galls. (210 galls. Victualling Ya
1 Cwt. = 1·8 cubic feet—11·2 galls.
1 Gallon = 277·2738 cubic in.—10 lbs. avoirdupois—7000 gr. T
1 Cubic foot = 997·137 oz. avoir. temp. 62°—62·5 lbs.—6·25 g
1 Cubic inch = 252·458 grains avoirdupois, temp. 62°.
1 Cylindric foot = 49·1 lbs.
1 Cylindric inch = ·02842 lbs.

Contents of Casks.

Leager	164 gallons.
Butt	110 ,,
Puncheon	72 ,,
Hogshead	54 ,,
Barrel	36 ,,
Half-hogshead	25 ,,
Kilderkin	18 ,,

Tanks.

No.	Galls.	Length. ft.	Length. in.	Breadth. ft.	Breadth. in.	Depth. ft.	Depth. in.	
1	600	4	1	4	1	6	1	Whole.
2	500	4	1	4	1	5	1	,,
3	400	4	1	4	1	4	1	,,
4	200	4	1	2	1	4	1	Half.
5	200	4	1	4	1	2	1	,,
6	193	4	1	4	1	2	1	,, (corner off).
7	200	3	3	3	3	3	3	,,

WEIGHTS AND MEASURES.

100	...	3	3	...	1	8	...	Quarter.	
100	...	3	3	...	3	3	...	1	9 ... ,,
375	...	4	1	...	4	1	...	4	1 ... Bilge.
264	...	4	1	...	3	7	...	4	1 ... ,,
110	...	3	3	...	2	7	...	2	10 ... ,,

BALLAST.

, 18, 20, and 40 to a ton. There are two sizes of 20, shorter and thicker than the other.

PROVISIONS.

.....Bags	112	lbs.
Puncheon	72	gallons.
Hogshead	54	,,
Barrel	36	,,
.... Half-hogshead	25	,,
Kilderkin	18	,,
Small Cask	12	,,
ef..... Tierce...	38	8-lb. pieces.
Barrel	26	,,
k..... Tierce	80	4-lb. pieces.
Barrel	52	,,
..... Barrel	336	lbs.
Half-hogshead	250	,,
Half-hogshead	168	,,
..... Small Cask	70	,,
Ditto	56	,,
Barrel	336	,,
..... Half-hogshead	224	,,
Small Cask.....	112	,,
..... Barrel	5	bushls=40 galls.
Half-hogshead	3½	,, =28 galls.
Barrel	7½	,,
l ..... Half-hogshead	5½	,, =44 galls.
Small cask	2½	,,
Ditto	2	

Sugar	Barrel	392 lbs.
	Half-hogshead	280 „
	Ditto	112 „
Chocolate	Half-hogshead	108 „
	Small cask	55 „
Tea	Chest	83 „
	Half-chest	36 „
Vinegar	Puncheon	72 gallons
	Hogshead	54 „
	Barrel	36 „
	Half-hogshead	25 „
	Kilderkin	18 „
	Small cask	12 „
Tobacco	**Barrel**	**150 lbs.**
	Half-hogshead	90 „
Soap	Half-hogshead	120 „
	Barrel	250 „

TABLE XIX.

FOREIGN WEIGHTS AND MEASURES.

FRENCH.

The French standard mètre is the unit of *length*. It is de the ten-millionth part of the arc of the meridian included betw pole and the equator.

The are, equal to one square décamètre, is the unit of *surfa*

The stère, equal to one cubic mètre, is the unit of *solidity*.

The litre, equal to one cubic décimètre, is the unit of *capaci*

The gramme, equal to one cubic centimètre of distilled wat temperature of 39° Fahrenheit, is the unit of *weight*.

By the centesimal division of the circle, the circumfer divided into 400 degrees, a degree into 100 minutes, and a into 100 seconds; consequently—

1 centesimal degree = 54 sexagesimal minutes.
1 centesimal minute ,, 32·4 sexagesimal seconds.
1 centesimal second ,, ·324 sexagesimal second.

e French decimal system, the prefix to the terms in the g scale is taken from the Greek numerals *deka*, *hekaton*, and *murias;* and in the descending scale from the Latin s *decem*, *centum*, *mille;* hence—

·a signifies ten times ; and *déci*, a tenth part.
·to signifies a hundred times ; and *centi*, a hundredth part.
·o signifies a thousand times ; and *milli*, a thousandth part.
·ria signifies ten thousand times.

, knowing the value of the unit of each measure, the equiva- the other terms employed is at once obtained by shifting the place. For instance,—

e = 39·37079 inches. Myriamètre = 393707·9 inches, or miles. Millimètre = 0·03937 inches. 16 Kilomètres = 10 miles,

= 119·60333 square yards. Hectare = 11960·33 squars yards, 11 acres. Centiare = 1·1960 square yards.

: = 35·31658 cubic feet. Hectostère = 3531·66 cubic feet, or ubic yards. Millstère = ·0353 cubic feet, or 61·0273 cubic in.

: = 1·76077 pints. Myrialitre = 17688 pints, or 2211 gallons. re = ·00177 pint. Hectolitre = 22 gallons, nearly.

nme = 15·434 grains. Myriagramme = 154340 grains, or 6 lbs. avoirdupois. Milligramme = ·0154 grain.

ddition to the various intermediate parts of the above—

1 Quinral = 220·485 lbs. avoirdupois.
1 Millier, or bar = 2204·85 lbs. avoirdupois.
1 Livre usuelle = 16 ounces = 1·10243 lbs. avoirdupois.
1 Once usuelle = 8 gros = 31·25 grammes.
1 Toise usuelle = 6 pieds = 6·56180 English feet.
1 Aune usuelle = 3·93708 English feet.
1 Boisseau usuelle = 2·75 imperial gallons

MEASURES OF LENGTH USED IN FOREIGN CH

FRENCH.

Pied and toise, as above.

Brasse, or fathom = 5·329 feet.

But in recent Charts the Mètre is invariably used, and the foll
Table will be of service.

Conversion of Mètres into English feet and fathoms.

1	Mètre	= 3·2809	Eng. feet	= 0·5468	Eng. fath.
2	,,	= 6·5618	,,	= 1·0936	,,
3	,,	= 9·8427	,,	= 1·6404	,,
4	,,	= 13·1236	,,	= 2·1873	,,
5	,,	= 16·4045	,,	= 2·7341	,,
6	,,	**= 19·6854**	,,	**= 3·2809**	,,
7	,,	= 22·9663	,,	= 3·8277	,,
8	,,	= 26·2472	,,	= 4·3745	,,
9	,,	= 29·5281	,,	= 4·9214	,,

By removing the decimal point as required, this Table has
extensive application :—thus 375 mètres = 984·27 + 229·66 + 16
1230·33 feet,—or 164·04 + 38·28 + 2·73 = 205·05 fathoms.

1851·852 mètres = 1 nautical mile; and 5·5555 kilometres = 1
league.

RUSSIAN.

Russian foot is equal to	1·145	English fe
Sashine	6·9995	,,
Arshine	2·33317	,,
Verst	0·66287	mile.

The Russians now adopt a *Sea* Sashine = 1 English fathom, cons
ing of 6 feet, each of the same length as the English foot.

SPANISH.

Spanish foot (pié) is equal to	0·9142	English fe
Braza	5·485	,,
Vara	2·74252	,,

ish Hydrographic Office is now using the Metro, equivalent
h Mètre, in their Sailing Directions and Nautical Notices.

DANISH.

(fod) is equal to ..... 1·0297 English feet
..... 6·1783 ,,
..... 4·68 English miles.

DUTCH.

alm (= 1 French Décimètre) is equal to 0.32809 English
, the Dutch Elle = 1 Mètre; and 1 Elle = 10 Palmer = 100

SWEDISH AND NORWEGIAN.

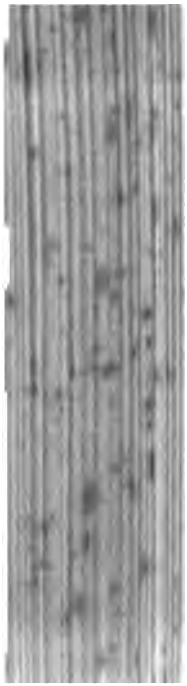
ot (fot) is equal to ..... 0·9741 English feet.
foot (fod) is equal to ..... 1·0294 ,,

PRUSSIA.

foot (fuss) is equal to ..... 1·0297 English feet.

MISCELLANEOUS CONTESTS.

celeration of the stars ..... = 3m. 55s. 9093.
ty ..... ,, 23h. 56m. 4·09s.
volution of the earth ..... ,, 365·2564 days.
radius of the earth ..... ,, 20923600 feet.
litto ditto ..... ,, 20853657 ,,
nce of the earth at equator ..... ,, 24900 statute miles.
1° of the meridian at the equator ..... ,, 362755·6 feet.
,, in lat. 45° ..... ,, 364609·4 ,,
,, at the pole ..... ,, 366479·0 ,,
tude at the equator ..... ,, 365233·7 ,,
in lat. 45° ..... ,, 258698·4 ,,
in lat. 60° ..... ,, 183083·3 ,,
. 9m. 20·63s or 2° 20′ 9″·45 E. of Greenwich.



CIRCLES.

1. The circle contains a greater area tha
bounded by an equal perimeter, or outline.

2. Circumference = 3·1415926 of diamet

3. Diameter = 0·31831 of circumfer

4. Areas of circles are to each other
diameters

5. Area = { square of diameter × / square of circumference ×

6. Diameter = square root of area × 1·12

7. Diameter of a circle of equal area = sid

8. Side of a square of equal area = diame

9. Area of the space contained between
sum of the diameters, × difference of the dia

TRIANGLES.

Right-angled Plane Tria

Two sides, or one side and an angle (excl
being given, to find the remaining parts :—

1. $\frac{P}{H}$ = sin. ; $\frac{P}{B}$ = tan. ; $\frac{H}{B}$ = sec., conseq

$\frac{H}{P}$ = cosec. ; $\frac{B}{P}$ = cotan. ; $\frac{B}{H}$ = cos. ; P =

$$a : b :: \text{sin. } A : \text{sin. } B.$$

sides and the included angle given, to find the remainder :—

$$\text{Tan. } \frac{A-B}{2} = \frac{a-b}{a+b} \quad \text{Cot. } \frac{C}{2}; \text{ then,}$$

$\frac{A+B}{2} + \frac{A-B}{2}$ = angle opposite greater side, and

$\frac{A+B}{2} - \frac{A-B}{2}$ = ,, less

or

$$\frac{a+b}{a-b} = \frac{\text{Tan. } \frac{1}{2}(A+B)}{\text{Tan. } \frac{1}{2}(A-B)}$$

ree sides given, to find the angles :—

t s = sum of the sides, then

$$\text{Cos. } \frac{A}{2} = \sqrt{\frac{\frac{s}{2}\left(\frac{s}{2}-a\right)}{bc}} \text{ or Cos. } A = \frac{b_2+c^2-a_2}{2bc}$$

ea of a triangle $= \frac{\text{base} \times \text{height}}{2}$

ea $= \text{sin. } A \times \frac{bc}{2}$; or $\frac{\text{sin. } A \times ab}{2}$

SQUARES.

a = square of one side.

a of a parallelogram = length × perpendicular breadth.

: of a square = square root of area.

gonal = $\sqrt{\text{side}^2 \times 2}$.

SPHERES.

face = diameter × circumference.

face = square of diameter × 3·1416.

meter = $\sqrt[3]{\frac{\text{contents}}{\cdot 5236}}$

ıtents = cube of diameter × ·5236.

ıtents in imperial gallons = cube of diameter × 3·263 if in feet,
r by ·001888 if in inches.

CYLINDERS.

1. Surface = length × circumference.
2. Solidity = length × area of base.
3. Contents, in imperial gallons = square of diameter × leng
   4.895 if in feet, or by ·002832 if in inches.

CONES.

1. Surface = $\frac{\text{slant height} \times \text{circumference of base}}{2}$
2. Solidity = $\frac{\text{perpendicula height} \times \text{area of base}}{3}$

OF AN ELLIPSE, OR OVAL.

1. Circumference = half sum of the two diameters × 3·1416.
2. Area = major axis × minor axis × ·7854.

CUBES, OR PARALLELOPIPEDS.

1. Solidity = length × breadth × depth.

THE WEDGE.

1. Solidity = (twice length of base + length of edge) × brea
   base × perpendicular height from base ÷ 6.

GRAVITY.

Let T = time, in seconds, that a body is in falling; V, the v
in feet, acquired in that time; and S, the space, in feet,
through. Then, the time being known,

1. $S = t^2 \times 16\frac{1}{2}$; $V = t \times 32\frac{1}{2}$; also,
2. $S = \frac{V^2}{64\frac{1}{2}}$; $V = 2\sqrt{S \times 16\frac{1}{2}}$; $T = \sqrt{\frac{S}{16\frac{1}{2}}}$, or, $\frac{V}{32\frac{1}{2}}$.

PROPORTION.

1. If $a : b :: b : c$, then $ac = b^2$, and $a : c :: a^2 : b^2$.

2. If $a : b :: c : d$, or $\frac{a}{b} = \frac{c}{d}$, then $a : c :: b : d$,

or, $a + b : a \sim b :: c + d : c \sim d$; and $ad = bc$.

3. If $a : b :: c : d$, and $e : f :: g : h$; then $ae : bf :: cg : dh$.

MISCELLANEOUS.

1.	Square inches	× ·007 = square feet.
2.	Cubic inches	× ·00058 = cubic feet.
3.	Ditto ditto	× ·003607 = imperial gallon nearly.
4.	Ditto feet	× 6·232 = imperial gallon nearly.
5.	Avoirdupois lbs.	× ·00893 = cwts.
6.	Ditto do	× ·00045 = tons.

APPENDIX.

BRIEF

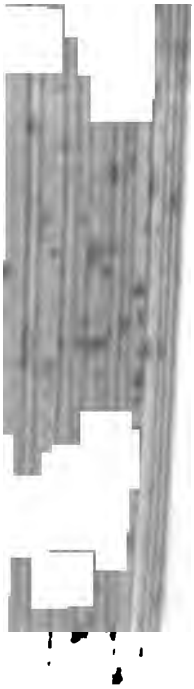
INSTRUCTIONS

FOR OFFICERS OF THE

MERCHANT SERVICE.

By W. H. ROSSER,

Author of the "Self Instructor in Navigation." The "Stars—how to know them, and how to use them." "Foreign Exchanges." "The Pacific Islands," &c., &c.



ŁIEF INSTRUCTIONS FOR OFFICERS OF THE MERCHANT SERVICE.

MASTER'S NAME ON SHIP'S CERTIFICATE OF REGISTRY.—
ı being appointed by the owner to the command of a
ıssel, you must forthwith see your name put on the Ship's
ɪrtificate of Registry as Master: in any port of the
ıited Kingdom this will be done at the Custom-house,
d the "Merchant Shipping Act" (with which every Ship-
ıster ought to be provided) will give you information as
the persons who are deemed Registrars in the Colonies
d elsewhere. It is unnecessary to give the form of this
ɪrtificate here, as it is supplied in the "Act;" it is a parch-
ɪnt document which the master must retain and have at
nd for production when required, as for instance at the
ıstom-house on the vessel arriving at a Port, on leaving
ɔrt, &c., and it is to be used only for the lawful naviga-
ɔn of the ship.

It should be borne in mind that the owners of a ship
ve always the power of superseding the master (provided
: is not part owner) at any time they please; and the
aster upon being so superseded, is bound to deliver up
e ship's certificate of registry to his successor,—the
ɪnalty of improperly retaining it being £100. Should

the master be superseded without good cause, he has his remedy against the owners for any loss or damage accruing to him.

CHARTER-PARTY.—The Charter-party is a contract "by which an entire ship, or some principal part thereof, is let to a merchant for the conveyance of goods, on a determined voyage to one or more places." It is not required to be drawn up in any precise form of words; this depends on the circumstances and character of the voyage, for as there are generally peculiar regulations and customs attached to special trades, so there must be a corresponding diversity in the form and terms of the Charter-party; thus, it must be so framed and worded as to suit the wishes and intentions of the parties concerned, and the trade in which the vessel is about to be employed. Such being the case, most mercantile firms have their own printed form of Charter-party, with blank spaces for the details relating to the trade for which the ship is hired. Nevertheless, it may be stated that the main features of this document have not varied for years past, for the most important questions involved in it refer to the risks and responsibilities of parties arising out of the usual perils of the sea, compensation for delays, alterations of the agreement, &c.; and it may be noted that the printed part is of as great weight as the written part.

The substance of a Charter-party is as follows:—The owners (or his agent, or the master) covenant to provide a ship, strong, staunch, and in every respect seaworthy; well and sufficiently found in sails, sailyards, anchors, cables,

, &c., and other instruments, tackle, apparel, furni-
provisions, &c., needful and necessary for such a
and for the given voyage, together with an able
er, and a sufficient compliment of seamen ;—binding
selves also that the cargo shall be delivered *(the act*
od, the Queen's enemies, and all and every other dangers
ccidents of the seas, rivers, and navigation, of whatever
re and kind soever, during the said voyage, always
ted) in like good condition as when shipped, and with
uch speed as may be, at the place of discharge agreed
ı : it fixes the terms on which the cargo is to be carried,
number of lay-days allowed for loading, and the
unt for demurrage, and the merchant or charterer
lates to comply with the payment promised for freight,
on demurrage, according to the terms of the contract:
both owner and charterer bind themselves in penalties
ıon-performance of the covenants, articles and agree-
ts, in the Charter-party. It is signed by the contracting
es in the presence of a witness, who also puts his
ıture to it ; but when charterer and owner (or master)
at different times, a witness is required to each signa-

In terms of the Stamp Act, to be a legal document,
ust be stamped.

etters altering a charter are liable to the same stamp
' as the Charter-party.

charterer may load the ship with his own goods, or
those of other parties ; or he may underlet the vessel
ınother party provided no clause in the Charter-party
ıibits him so doing

they thereby enter into, care should
tains no provisions which are unusu
prejudicial to the rights of the parties

When a ship is chartered by the
months are understood, and the mas
kind of cargo which is not injurious t
quantity within its carrying capacity,
sions in the Charter-party restrict this

If the ship is chartered for a lump
water should be specified in the Cha
over loading.

In chartering, do not allow the char
unless you approve of his principal;
shall not be liable for any delay in l
responsibility shall cease when the car
that the ship shall discharge in turn
the custom of the Port); nor that th
bills of lading at any rate of freight
without qualification.

The ship must be properly dunnag
usages of the trade in which she is e

State whether the *lay-days* are "running days" or "working days," according to the intention. Also be particular about the number of days and the amount to be paid *on demurrage*.

Lay days commence from the day when the ship is in her place of discharge (as per Charter-party), or as near thereto as she can safely get. The place of discharge is determined by the custom of the Port and the usage of the trade in which the vessel is engaged.

When no *lay days* are specified, the length of time for loading and unloading must be determined by the nature of the cargo, or the number of days usually allowed at the Port. To be valid, the custom or usage of the Port must be a legal one.

If the owner or master is bound to provide ballast, he may put in heavy merchandise, provided that it occupies no more space than ballast would do, and is not injurious to the cargo.

If it is intended that the deck load is to be entirely at merchants' risk, let it be so stated in the Charter-party, otherwise the shipowner must bear his share of the loss, in general average, if it is jettisoned, and he cannot recover the amount from the under-writers.

As soon as the vessel has taken in the full complement of cargo, and all things necessary are arranged, as clearing at the Custom house, payment of Port charges, &c., the voyage must be forthwith commenced, *weather* permitting.

The master must not take on board any contraband goods, or have in his possession any false or colourable

papers whereby the ship and cargo are rendered liable to seizure; but he must obtain all papers and documents which are necessary to protect the ship and cargo in all the countries to which he is trading.

By the terms of the Charter-party, not to be held liable for injuries arising from "the act of God, and the Queen's enemies, &c.," the master or owner is not responsible for damage arising from the sea, winds, &c., unless such injury or damage be the result of negligence or imprudence.

When the Charter-party names a full and complete cargo the master must take on board as much as he can, and *safely*, and without injury to the ship: and the freighter is obliged to furnish the same, either of his own goods, or the goods of others.

The Charter-party should stipulate for a *full* cargo, if that is intended, otherwise the charterer will only be liable to pay on the quantity of goods which he ships, *unless* he has agreed to pay at the rate of so much per ton of the ship's capacity.

If any clause of the Charter-party is ambiguous, the interpretation should be liberal; or if the Charter-party is silent in respect to any point, the usage of the trade in which the ship is employed must be adopted.

No master should consent to vary the terms of the Charter-party, or alter his voyage, without the greatest caution, and then only with the charterer himself or his agent, having his written consent, which written consent ought to be given up to the master before making the alteration, otherwise the charterer will be discharged from the con-

, and the owner liable to an action for breach of act. If there be a telegraph, it would be better for master to refer to his owner for instructions.

the Charter-party is entered into by the master, then ust be sued by the charterer in case of any dispute, ss the master, in signing, expressly states that he signs as agent for the owner.

by the terms of a Charter-party, the ship has to eed to a given Port, the merchant covenanting to sh a cargo there, and on arrival the contracting party, is agent, is unwilling or unable to furnish a cargo, the er should, on the expiration of the lay-days allowed harter, protest against the merchant for non-fulfilment e Charter-party, and he is then at liberty to return in st, and has a right to the full freight. *The better plan*, ever, is to take the best homeward freight he can get, claim the deficiency of freight from the merchant. not necessary to wait the demurrage days unless re- ed so to do by the merchant or his agent. A ibition by the government of the country to export proposed articles of cargo, neither disolves the con- , nor excuses the non-performance of it. Send the est home to the owners.

a consignee refuses, and persists in his refusal, to receive o within a reasonable time, the master had better, r consulting with and entering a protest before the sul, sell the cargo for what it will fetch, and proceed he Charter-party for the balance of freight, if any.

f while loading it becomes an admitted fact that the

cover freight, demurrage, &c., a
given on the cargo to cover the sa
sail to her destination, and so d
insure payment of such charges.

Depth of water at discharging or
to draught of ship.—This is a very
master to ascertain before the ter
are settled and signed, as a vessel
spring-tide to enter and depart; e
barred harbour, and she may have
partly in the roads, and partly in t
she may, from her draught, not
harbour at all, and thus have to loa
roads; in any case, unless, accor
such provisions as—"so near as
"lighten and load at merchant's exp
lent words are introduced into
expenses entailed on the ship may
and, in fact, a loss. Only in the
regular custom of the port to light
gets to her final berth, will the merc

To Messrs.———

As the Lay-days for loading my ship———— on————last; and as, according to the Charter- ou have not yet supplied a full Cargo, I hereby that you will forthwith inform me whether it is ention to supply any more Cargo.

take notice, that unless the remainder of the Cargo lied before————next, I shall, at the expiration ime, proceed on my voyage with the quantity of ou have supplied to the said ship, and you will liable for Dead-freight and Damages for not sup- . full Cargo, according to Charter.

Dated this———day of———18—

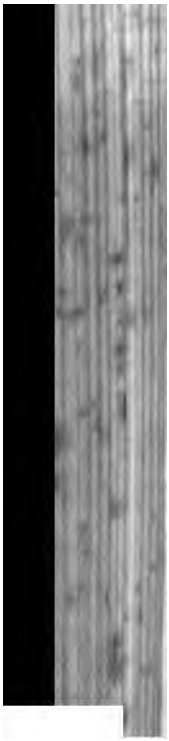
A. B.,

Master of the———

of Notice to be given after the Lay-days and Demur- 's are expired, and no Cargo has been supplied:—

To Messrs.———

I hereby give you notice that the Lay-days for my ship———expired on———last, and as you ıt yet supplied any Cargo, I require you forthwith mence to load the said ship, according to the -party. Should you neglect to do so, I shall, ——next, hold myself at liberty to depart in ballast ıarter the ship, according to circumstances, and ll be held responsible for all loss and damages



A. B.,

Master

N.B.—Keep copies of these Notic
the Log Book.

A BILL OF LADING is a *formal re*
master of the ship in his capacity of
acknowledges that he has received the
board his ship, and binds himself (unde
to deliver them, in the condition re
and to the person named in the bill,
his or their paying him the stipulated
no charter-party, then the Bills of Lad
of the contract, and of the shipment of

The usual form of a Bill of Lading i

X Y, No. 1 a 12. N.B.—Shippe
well conditioned,
in and upon th
whereof A. B. is
and bound for-
following, viz.,—

and all and every other dangers and accidents of the seas, rivers, and navigation, of whatever nature and kind soever, excepted) unto the said D.E. or his assigns, he or they paying for the said goods at the rate of——— per ton freight, with primage and average accustomed. In witness whereof, I, the said master of the said ship, have affirmed to three bills of lading, of this tenor and date; any one of which bills being accomplished, the other two are to be void.

London, this——day of——18—.

A. B.——, Master.

e induced to sign Bills of Lading before the goods rd, or without the mate's receipts being given up ed, or without first carefully reading them over aring one with the other; not only see that they and that the quantity of goods and rate of freight :t, but that nothing is inserted contrary to the e Charter-party if there be one.

sign Bills of Lading for a less freight than tated in the Charter-party, but say—"Freight, :, and *all other conditions* as per Charter," for gnee of the cargo is ordinarily only liable to the requirements named in the Bill of Lading,

as he does not necessarily know the terms of the Charter-party.

Insert the correct number of days consumed in loading on the margin of the Bill of Lading.

Demurrage and Lighterage are money advanced, and address commission paid on part of loading, ought to be entered on the Bills of Lading. This is a receipt which the merchants of the cargo cannot dispute.

According to circumstances and the state in which goods are shipped, qualify your risk by adding—"quantity and quality unknown," or "weight and quantity unknown," or "number and [illegible] unknown," or "number and [illegible]

[illegible] to the master signs to the letters [illegible] to see them. [illegible] to use the lighter [illegible] This master will, however, [illegible] to do this to [illegible] shipped [illegible] shipped in the lighter

[illegible] answerable for [illegible] goods—not answerable for [illegible] protected so far as the [illegible] from accidental causes, not [illegible] to negligence or want of care.

[illegible] shipper's or consignee's risk, even if [illegible] or otherwise.

If the shipper refuse to allow the qualifications stated above, or the insertion of any words the master considers

) be inserted on the bill of lading, sign under thus :—

"*Signed under protest,*"

A. B., Master.

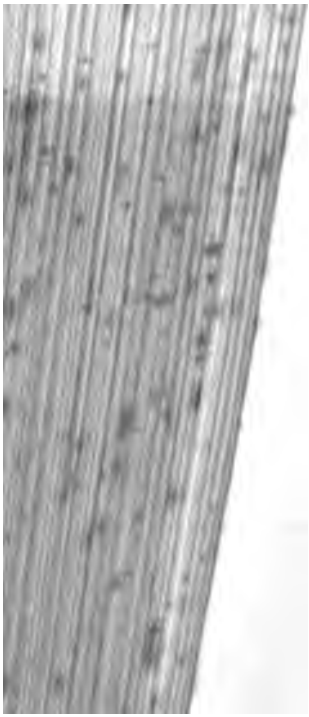
)f Lading, when there is no Charter-party, should Consignee paying freight, demurrage, and all other '; also, "goods to be taken from alongside at ee's expense and risk."

gland it is customary in the case of ships loading cargoes for abroad, to sign Bills of Lading for aid in advance, but not to receive it for a month eeks after the sailing of the vessel: in this case, evertheless the owners to have a lien on the r freight until paid."

Bills of Lading should be stamped; one for the another for the consignee, and the third for the use and guidance in delivering cargo; but a iires no stamp. A master is not bound to sign a Lading unless it is properly stamped, as it cannot ıped afterwards. In England the penalty for ın unstamped bill of lading is £50.

ster of a ship, on signing Bills of Lading, ought o understand he is only required to give a receipt cargo; not to enter into a second agreement; ıe necessity of referring to the Charter-party in the Lading for "freight and conditions"—the Bill of being the last document signed.

ster has no right to insert any new conditions in



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Refuse to
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protest, and sai
as to the conte
A master mus
in whatever lang
sign a documen
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to have them expl
as some of them
God; the Queen's
objectionable clause
translated, add—"fr
Charter-party; and a
After signing one
another set unless thos
to you to be destroyed
liabl

breach of contract. An indorsee, however, who
s it again to another party, does not remain liable
dorsing it away.

ver the cargo to no one unless he produce one of
ls on Lading which you have previously signed,
y endorsed.

ll of Lading may be negociated by simple indorse-
nd delivery, which will carry a right to the goods.

DAYS.—This is the term applied to the number of
pecified in the Charter-party for loading and dis-
g a vessel.

general rule, *i.e.*, in the absence of a custom of the
r a stipulation to the contrary, "lay-days" mean
ng days," and include Sundays and fixed holidays;
ception being where the ship has reported too late
Merchant to begin discharging in fair time on
y, in which case the Merchant would be entitled
in to count his "lay-days" from the following
y, or first *working* day, which the late reporting of
ip on Saturday gives him the advantage of; the
days would then run on as *running* days—the
ling Sundays and holidays counting as "days"
the Merchant. Also, in most Continental ports,
ng to usage, holidays count as Sundays, in which
e Merchant would not recognize a notice given on
day, and the ship's time would only count from the
er the holiday. In London, however, by the custom
port, "days" are held to mean "working days,"
otherwise specified.

"Lay-days, Sundays excepted," mean "working days," Sundays not counting as days.

"Running lay-days" mean every day to count, viz.: working days, Sundays, and holidays.

"Lay-days," subject to the exceptions stated above, are to be construed to count as "running lay-days."

In calculating a ship's "days," part of a day is reckoned as a whole day; thus, though discharging did not commence until 2 h. or 3 h. P.M., that day would count against the Merchant.

Lay-days for discharging cargo commence the day after the vessel is entered at the Custom House, and after her arrival at the usual place of discharge in the port; but she must be *ready* to discharge her cargo before the days begin to count; and if some particular place in the port is specified in the Charter, they do not commence until that place is reached. If a vessel can get over a bar at spring-tide, and afterwards discharge afloat, she must wait for the springs, and the lay-days will not commence until she is in her place of discharge.

If a vessel is, according to her Charter, always to lay afloat, and has arrived within the limits of her port of discharge, or as near thereto as she can *safely* get, and has to be lightened to reach her final discharging berth, the days, day, or part of a day consumed in towing up to, or otherwise reaching that final place, would count in the lay-days.

Also, if the clauses of the Charter-party stipulate "calling at C——for orders, which are to be given in—

hours, or lay-days commence," and "——days at Port of delivery for unloading," then the lay-days commence at C——after the expiration of the given hours allowed for receiving orders, and they may be deducted from the days allowed for unloading.

"Regular turn" is explained and governed by the usage of the Port; and a vessel's lay-days in this case commence when her turn comes.

"Usual dispatch" is held to mean the usual dispatch of persons who have a cargo in readiness; and "reasonable time," if there is no usage of the port to decide the question, means a reasonable time under *ordinary* circumstances.

If a vessel is duly loaded within the time named as lay-days, and she is ready for sea, the Charterer has no power to detain her.

Form of Notice that Ship is ready to Load:—

To Messrs.———

Take Notice that my vessel the———is now lying at ———, and is now ready to receive her cargo. The Lay-days, according to Charter-party, commenced———, and will exipre on———; after which time the vessel will be on Demurrage.

Dated this——day of———18—.

A. B., Master of the———

Form of Notice that Ship is ready to Unload.

To Messrs.———

Take Notice that my vessel the———arrived here ———, and is now ready to unload. The Lay-days for discharging the cargo will expire on———, and after that date you will be liable, per Charter-party to pay Demurrage at the rate of £———per day. If the discharge of the cargo is commenced before you pay the Freight, I will reserve my right to detain a sufficient portion of the cargo until said Freight is paid.

Dated this— —day of———18—.

A. B., Master of the———.

N.B.—Do not forget to keep copies of these notices, and a memorandum of the date on which they were delivered.

DEMURRAGE. If a vessel is detained, either in loading or unloading, for a longer term than the number of days stated in the Charter-party, or on the Bills of Lading, the Shipowner is entitled to *Demurrage*, the rate of which, *per day*, is also stipulated for in the Charter-party.

Demurrage can only be claimed for detention at the port of loading, and at the port of discharge. It should also be claimed day by day as it arises, and on Saturday for Sunday, for *all* days count on demurrage, even if the Charter-party specifies that the Lay-days are to be working

nly. Further, if no notice has been served on the ant for Demurrage, the claim resolves itself into f undue detention, which must be proved, and is le the Charter-party.

ship-owner has no lien on the cargo for Demurrage, ss that is a stipulation in the Charter-party or Bills ading.

f a Charter-party provides for a certain number of days *demurrage*, at a given rate per day, and the vessel is tained longer than the time specified, then, for the ditional term, the ship-owner is not restricted to the ount of demurrage named in the Charter-party; but the ly way to secure a claim on an increased scale, is to give ple notice that if the vessel is detained beyond the days med *on demurrage*, an increased rate per day will be rged as compensation for the detention.

If lay-days are not mentioned in the Charter-party or ill of Lading, the vessel must be loaded or unloaded with asonable dispatch; and if demurrage is supposed to ecrue, it must be regulated by the custom of the Port, by e decision of arbitrators, or by a jury, as to what, under e circumstances, would be a fair and reasonable time for ading or discharging.

The owner is the proper party to sue in a demurrage ase.

Form of Notice that Ship is on Demurrage:—(Loading.)

To Messrs.———

Take notice that the lay-days for loading my vessel,

the————,expired on————and since that time she has been, and is still on demurrage, for the payment of which you and all concerned will be held liable.

Dated this————day of————18—

A. B., Master of the——

Form of Notice that Ship is on Demurrage:—(Discharging.)

To Messrs.————

Take notice that the lay-days for discharging the cargo in the vessel the————, have expired, and that she is now on demurrage, for the payment of which you and all concerned will be held liable.

And take notice that if you neglect forthwith to discharge the said cargo, you and all concerned will be held liable for all expenses of storing the same, should it become necessary to do so.

Dated this————day of————18—

A. B., Master of the————

N.B.—Do not forget to keep copies of these notices and a memorandum of the date of delivery.

CARGO AND ITS STOWAGE.—Owners and Masters are sometimes apt to live in the same situation as common carriers, and it cannot be too clearly understood that the payment

Freight very much depends on the care bestowed on the go. All due precautions must therefore be taken to ceive and stow cargoes in good order, so that the goods y be delivered in the like good order and condition (the t of God, dangers of the seas, &c., excepted).

Owners have often had large sums to pay for damage to go, arising from the following causes, which with ordin- y care might have been prevented:—runs not being ar; dunnage not being good and sufficient; ship not ing properly matted out; pump well, mast cases, bulk- ads, shifting boards, and chain locker not being sub- ntial and secure; neglected air ports, by which cargo ches the pumps and chokes them; leaky ports; cover- g of hatchways and coating of masts being insufficient imperfect; inattention to pumps; improper stowage; tting timber or deals, and breaking open packages (for wage) beyond what is provided for by the Charter, by usages of the trade, or without the written consent of charterer or shipper; deck load being carried over a rishable cargo; rats, mice, and other vermin.

The law holds the shipowner liable for the safe custody the goods when properly and legally received on board good order, and for the "delivery" to parties producing Bills of Lading.

Goods are not unfrequently sent alongside in a damaged te, and letters of indemnity given to the master by the ippers for signing in good order and condition; this is thing more or less than conniving at fraud. Fine goods e often damaged in the ship's hold by lumpers, if per-

the after part of the fore hatch to the fore part of the after hatch, keeping the bars an inch or two apart; carry it over to the wings right up both sides, taking care to have mats along the sides to keep the chafe off the skin; bring it up from the ends in a slant towards the main hatch; secure it by tomming it off from the beams, with planks under the toms.

A part cargo of iron stow fore-and-aft from the after part of the fore hatch to the fore part of the after hatch, until level with the keelson; then grating-fashion, and bring it up square at the ends.

All dead weight as iron, copper, lead, and other metals, used to stiffen the ship, should be stowed in the bottom, from the after part of the fore-hatch to the fore part of the after-hatch.

Stow a heavy piece of machinery in the centre of the main hold.

To stow a cargo of copper ore.—A good substantial platform should be built above the keelson, and a trunk-way formed by building strong bulkheads in the wings, well shored and cleated from the sides; by this means you keep the dead weight in the body of the ship, rising it, and rendering the ship easier in a sea-way. N.B.—If materials for building a trunk-way are not available, good strong casks (the head-staves perpendicular) will make a good substitute; the ground tier forming the platform, and winging up with casks at the sides.

To stow guano.—The hold and limbers having been prepared, dunnage as high as the keelson, and three or

air-holes are filled in. N.B.—Shi
sufficient bags and twine by the shipp

Or, build a platform as high as
partially fill bags with guano, so tha
bottoms of the half-filled bags shall la
each other; line the lower hold in t
in with guano in bulk. By this plan
twine, but the former method is pre
ship to be balked at the ends by fille

To stow a cargo of tea.—Dunnage
dry stone ballast even with the upper
or higher, according to the vessel's sta
of chests you can stow under the low
the ballast and round it down towar
it the same curve as the deck and b
sufficient ballast fore and aft in bot
the three lower tiers. The ballast sh
with *thin dry* boards, and the ground

filling and chocking off with ballast. When the tier is stowed it should be a perfect level, fore and ith a gradual droop towards the wings, according to urve of the beams. Above this tier dunnage the sides 3 to 4 inches, up to the lower beams—in the 'tween ks 1 to 2 inches of dry dunnage laid athwartships—sides same. The pump well, chain locker, masts, &c. uld be *well* dunnaged. N.B.—With a tea cargo great e should be used in selecting dry hard stone or shingle; e same remark applies to the dunnage.

The following instructions for stowage of various cargoes e according to Lloyds' rules :—

HEMP, FLAX, WOOL, and COTTON, should be dunnaged inches on the floors, and to the *upper part* of the *bilge*, e wing bales of the second tier kept 6 inches off the side t the lower corner, and 2½ inches at the sides. Sand r damp gravel ballast to be covered with boards. *Sharp-ottom ships one-third less dunnage in floors and bilges.* Avoid Horn Shavings as dunnage from Calcutta.

All CORN, WHEAT, RICE, PEAS, BEANS, &c., when in bulk, to be stowed on a good high platform, or dunnage wood, of not less than 10 inches, and in the bilges 14 inches dunnage; the pumps and masts cased, to have strong bulkheads, good shifting boards, with feeders and ventilators, and to have no admixture of other goods. Flat-floored, wall-sided ships should be fitted with bilge pumps. On no consideration must the stanchions under the beams be removed.

Oil, Wine, Spirits, Beer, Molasses, Tar, &c., to be stowed bung up; to have good *cross beds* at the quarters, (*and not to trust to hanging beds*), to be well chocked with wood, and allowed to stow three heights of pipes or butts, four heights of puncheons, and six heights of hogsheads or half-puncheons. All moist goods and liquids, such as Salted Hides, Bales of Bacon, Butter, Lard, Grease, Castor Oil, &c., should not be stowed too near "dry goods," whose nature is to absorb moisture. Ship-owners have often to pay heavy damages for leakage in casks of Molasses, arising from stowing too many heights without an intervening platform or 'twixt decks. From Bengal, goods also are frequently damaged by Castor Oil.

Tea, and Flour in barrels; Flax, Clover, and Linseed, or Rice in tierces; Coffee and Cocoa in bags, should always have 9 inches at least, of good dunnage in the bottom, and 14 inches to the upper part of the bilges, with 2½ inches at the sides; allowed to stow six heights of tierces and eight heights of barrels. All ships above 600 tons should have 'twixt decks or platforms laid for these cargoes, to ease the pressure—caulked 'twixt decks should have scuppers in the sides, and 2½ inches of dunnage laid athwart ship, and not fore-and-aft ways, when in bags or sacks; and when in boxes or casks not less than 1 inch. Rice from Calcutta is not unfrequently damaged by indigo, for want of care in stowing.

Entire cargoes of Sugar, Saltpetre, and Guano, in bags, must have the dunnage carefully attended to, as laid down for other goods. Timber ships are better without 'twixt

ks if loading all timber or deals. Brown sugar to be
t separate from white sugar, and both kept from direct
tact with Saltpetre.

'OT and PEARL ASHES, TOBACCO, BARK, INDIGO,
DDERS, GUM, &c., whether in casks, cases, or bales,
be dunnaged in the bottom, and to the upper part of
bilges, at *least* 9 inches, and 2½ inches at the sides.

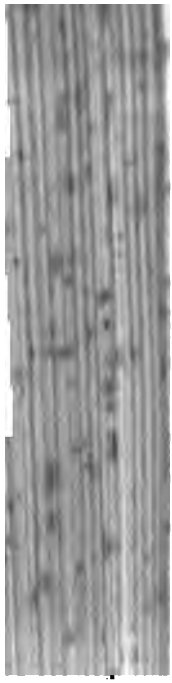
MISCELLANEOUS GOODS, such as boxes of CHEESE,
s and tubs of LARD, or other small or slight-made
kages, not intended for broken stowage, should be
ved by themselves, and dunnaged as other goods.

Barrels of PROVISIONS, and TALLOW Casks, allowed to
v six heights. All METALS should be stowed under,
separated from goods liable to be damaged by
tact.

All MANUFACTURED GOODS, also DRY HIDES, Bales of
K, or other valuable articles, should have 2½ inches
dunnage against the side, to preserve a water-course.
idles of SHEET IRON, RODS, pigs of COPPER or IRON,
any rough hard substance, should not be allowed to
ie in contact with bales or bags, or any soft packages
le to be chafed. When mats can be procured they
uld be used at the sides for Silk, Tea, &c.

TAR, TURPENTINE, RESIN, &c., to have flat beds of
od under the quarters, of an inch thick, and allowed
stow six heights.

Very frequent and serious loss falls on merchants on
upper part of cargoes, particularly in vessels that
ng wheat, corn, tobacco, oil cake, &c., arising from



Ships laden with full cargoes
Cape Horn, or Cape of Good Hop
approved ventilators as a preventiv

No vessel bound on any over-sea
account be loaded beyond that poi
will present a clear side out of water,
inches to every foot depth of hold, me
the height of the deck at the sid
stowing, 42 cubic feet measurement

STOWAGE OF GRAIN CARGOES FR
UNITED STATES.—No ship exceedin
be entirely loaded with grain in bu
400 tons register may take two-thir
bulk, and one-third in bags, or
thereof. In the latter case, the g
stowed six inches, but not more abo
for settling.

When ships take wheat, corn, &
stowed in sections or "bins" (not

ding at least six feet downwards and fitted tight to eck. The stanchions not to be removed, but firmly ed. No loose grain to be stowed in the extreme and no admixture of other goods. Pumps and masts l and covered with mats or canvas, made thoroughly -tight, with sufficient space in the well to admit the ge of a man to the heels of the pumps, and access o the same by means of a man-hole from the deck, a clear passage from the 'tween decks aft. Mats to sed for covering knees, keelson, and stanchions, if red, but not for lining or covering the sides.

ain, when stowed in bags, must be dunnaged not less 10 inches on the floor, 14 to 16 inches in the bilges, hes on sides up to the deck; between decks the dun- must be laid thwart ships, at least 2 inches from the . Shifting plank extending at least 4 feet from deck ıs downwards, secured to stanchions. The dunnage e hold must be entirely covered with boards and sails, ats, grain-tight.

l bulk or loose grain must be taken in bins prepared ıat purpose.

ır dunnaging deals are preferable to anything else. r should be laid fore and aft about 3 inches apart, the ıd tier over the spaces of the first tier, the third tier the spaces of the second, and so on. Staves or other rials generally used for dunnage to be placed so as to free course for the water to reach the pumps. The ıage should be raised from 10 to 12 inches from the , and in the bilges from 14 to 16 inches, according to

the build of the ship, and the discretion of the Inspector. Flat-floored, wall-sided ships should be fitted with bilge pumps.

The studs for the bulkheads should be made of three-inch deals, placed about two feet apart, and firmly secured at the top and bottom, and properly braced and cleated on the lining and to the beams (or deck), to resist the pressure of the grain.

The studs for the bulkheads forward, and after bulkheads for ships not exceeding 10 feet depth of hold, must be 4 by 6 inches in size, and of one entire piece; of a greater depth than 16 feet, they must be 4 by 8 inches. They must be set 20 inches apart from centre to centre, firmly secured at the top and bottom, and properly braced and cleated on the ceiling and deck, to resist the pressure of the grain.

The sides above the turn of the bilge must be lined on 1 inch battens after the manner of clap-boarding.

Shifting planks 2 inches thick must extend to the deck on each side of the stanchions, fitted tight under and between the beams and carlines, and extending not less than 6 feet downwards; care must be taken that the stanchions are well secured at both ends. In no case can single boards be substituted for plank, and the shifting-boards must be shored from sides, midway between the stanchions.

Materials for bins must be perfectly seasoned; unseasoned lumber must not be used where it will come in contact with the grain. Water-tanks, whether of wood or

[redacted], must be cased with wood to prevent damage from [redacted] or leakage. And all ships with grain in bulk ought [redacted] have feeders and ventilators.

It must be seen that the grain is well trimmed up be[redacted] the beams, and the space between the beams com[redacted]ly filled.

When ships are chartered, the draught of water should [redacted] limited, and provision made for loading under in[redacted]pection.

The load-draught must be regulated by the depth of the [redacted]old, allowing three inches to every foot depth of hold, [redacted]easured from lowest line of sheer of deck amidships to [redacted] water, when upright. Ships having an additional [redacted]eck put on after construction, the depth of hold to be [redacted]easured from original deck.

Ships loading grain complying strictly with the above [redacted]ules, lined and loaded under the supervision of the sur[redacted]veyor appointed by Lloyds' agent, will be entitled to a [redacted]ertificate to that effect.

Caution.—Never stow any part of the cargo, nor put [redacted]any stores in the space allotted to the crew, as each man [redacted]can claim one shilling per day for the whole time that the [redacted]crew space is so occupied.

FREIGHT is the sum which the merchant pays for the [redacted]safe conveyance of cargo, or for the use of the ship; it is [redacted]payable according to the terms of the Charter-party.

Do not make the freight payable two months, or any time *after* the delivery of cargo, but either "during the delivery," or "on delivery." When bills are to be given, have them good and approved bills, and not charterer's

acceptance. When foreign money is to be paid, make it "at current rate of exchange."

When an advance of freight is to be paid, make it payable on signing Bills of Lading, and not on the sailing of the ship.

If it has been necessary to abandon the vessel, freight will be earned by conveying the goods to their destination by the best means which circumstances will admit of.

Freight cannot be claimed on damaged cargo sold at an intermediate port; hence, it is always better to put it into the best condition possible, and bring it on.

If the freight is calculated by time, it begins to run from the period of the ship's breaking ground, and commencing her voyage.

The owner has a lien on the cargo for freight, but none on goods conveyed for dead freight.

A ship having been fully chartered to the charterers, the master has no right to fill his cabin for his own or his owner's benefit, so as to receive "extra" freight as against charterers; the latter may claim compensation on showing loss. The master's is a permissive custom rather than a right.

If goods have increased in bulk (as in the case of grain), freight must be calculated on the quantity put on board; if there has been a decrease (as in the case of molasses, &c.,) it must be calculated on the quantity delivered.

Where a lump sum has to be paid for freight, and a part of the cargo only is delivered in consequence of some accident, a proportionate sum will be payable.

Though the cargo be so much damaged when the ship arrives at the port of destination as not to be worth the freight, the merchant cannot avoid payment of the freight by abandoning the cargo to the ship-owner, from whatever cause the damage may have arisen.

"Right and true delivery," means delivery of the right quantity, although the quality may be damaged.

Where the amount of freight named in the Bills of Lading differs from that named in the Charter-party, the master can only claim from the consignee the amount named in the Bills of Lading, and the lien on the cargo is only for that amount: the balance must be claimed from Charterer.

The master can detain for the freight any part of the cargo consigned to the same person: also, in case the cargo is damaged, or where there is short delivery, he can hold it till the whole freight due on the quantity delivered is paid.

PROTESTS AND SURVEYS.—It is always safe and judicious, even when no damage to cargo is apprehended, to note a protest, "against wind and weather," within 24 hours after the ship's arrival at her port; if need be, this protest can then be extended according to the exigencies of the case. A protest is made before a Notary Public; if there is no such person, then before a British Consul, a magistrate, or the collector of customs. Keep a copy of the noting, and have it signed as a "true copy."

A ship having received damage, or having touched the ground during the voyage to her port of loading, ought to

be surveyed, and a certificate of her sea-worthiness, in duplicate, obtained before taking on board cargo.

If it is found necessary to put into an intermediate port for repairs, the master must have a certificate of survey on the damage received, and the ship's sea-worthiness before leaving. If the cargo be a perishable one, and there is reason to think it is damaged, it will be necessary to have a survey on it, and obtain a certificate that it is, or has been, put into proper condition for the passage to the port of destination.

If in consequence of bad weather there is reason to suppose the cargo has been damaged, before opening hatches at the port of discharge, get two shipmasters (as surveyors) to inspect them, and obtain from them a certificate of survey (in duplicate), stating that the hatches have been well parcelled and battened down; the same surveyors can also inspect the damaged packages of cargo, and certify as to whether they were properly dunnaged and stowed, giving a certificate respecting them.

Under any circumstances let the surveyors, when a certificate of survey is necessary, be two shipmasters, or a shipmaster and a merchant uninterested in the cargo.

A certificate of survey, specifying that the hatches were properly battened down, and the cargo sufficiently dunnaged and generally well stowed, but that the goods were damaged by sea water, prevents a claim being made on the ship for the amount of damage.

When you proceed to extend your protest, take with you to the Notary the certificates of survey and the log

book, and leave them with him till the claims are settled: be careful that whatever statements you make are correct.

The owner should have a copy of the certificate of survey, and also of the protest, transmitted to him by post; the other the master keeps *for his own use.*

CALLING FOR ORDERS.—When you call at one port for orders to discharge or load at another, ask for your orders in *writing*, and take care of them, as they will be useful in case of dispute.

AN INVOICE for shipping purposes is an account of goods sold or consigned, containing a description of the goods, with their marks and numbers; their prime cost; and charges, which include freight, insurance, entry bond duty, dock charges, lighterage, &c.

A COCKET is a Custom-house warrant, given on the entry of goods for exportation, in evidence of their having paid duty, or being duty free.

MANIFEST.—This is a document made from the Bills of Lading, dated and signed by the master at the place of lading. It sets forth the ship's name; Port of registry; registered tonnage; master's name; a specific account and description of *all* goods on board, with the marks and numbers thereon; the names of the shippers and consignees; the place or places where the goods have been received on board, and the place or places for which they are respectively destined; and in fact, *full particulars* relating to the ship, the cargo, the crew, and the passengers, if any.

It must be handed over to the Custom-house authorities

on the arrival of the ship at the port of destination; and must also be ready to be produced at any intermediate port the ship puts into. In many places goods on board and not in the manifest are not only liable to confiscation, but the master is subjected to a heavy penalty for the omission; and no such ambiguous term as "merchandise" is admitted.

ENTRY INWARDS AND CLEARANCE OUTWARDS.—The master must immediately on reaching his port of destination see that his vessel is *entered inwards* at the Custom-house, and take with him the manifest and all the necessary papers for that purpose. So, on his departure he must likewise have his *clearance outwards*.

BILL OF HEALTH.—Every ship on leaving port should be furnished by the sanitary authority with a bill of health, which should be countersigned by a Consul of the country to which she is bound, otherwise she is liable to unnecessary delay and detention in quarantine; a similar bill should be obtained at intermediate ports belonging to different countries.

BOTTOMRY AND RESPONDENTIA.—Bottomry is the mortgaging of a ship, when, in a foreign port, the master cannot obtain money on his own, or his owner's credit; it is a bond whereby the ship is pledged as security for the repayment of money borrowed to repair the ship, and so complete the voyage: the money advanced, together with the premium or interest, becomes repayable on the ship terminating the voyage successfully,—the vessel as well as the borrower being then liable for the money lent.

If the ship is lost, the lender loses the money; and ince he has to sustain the hazard of the voyage, he is llowed a greater interest or premium than the usual rate cknowledged by law.

If on a voyage, two or more bottomry bonds be entered ıto, the last is payable first, since they take precedence ı the reverse order of the bonds being taken up.

Money borrowed on bottomry must be obtained by ıvertisement, and the lowest offer (of interest) accepted.

The seamen's wages must be paid before the bottomry ond.

If money is necessary and it cannot be obtained on ottomry, the cargo may be pledged: this is *respondentia*, nd is subject to the same laws as bottomry.

If money cannot be obtained on bottomry or on espondentia, the master may sell a part of the cargo.

AVERAGE, in the law of shipping, is generally applied to ıe loss occasioned by any sacrifice made to insure the ıfety of a ship and cargo; it is usually settled by an average adjuster."

PORT CHARGES are generally taken to include pilotage, ›wage, harbour and hospital dues, &c., and whatever harges of a similiar description are customary at any ıven port.

SHIPPING AND DISCHARGING CREW,—SHIP'S ARTICLES F AGREEMENT,—VICTUALLING SCALE.—A few days be-›re the ship is ready for sea, attend at the Shipping Office nd state your requirements as regards hands, &c.; you ·ill there be furnished with all the necessary preliminary

papers, and the seamen will, in due course, be procured for you, and desired to attend on the day you propose to *sign Articles*. These Articles of Agreement state the character of the voyage, and fix the *status* of each of the crew, the rates of wages, the scale of victualling, &c. On the given day, and at the given time, the Articles of Agreement, the Victualling Scale, and the Regulations for maintaining discipline (sanctioned by the Board of Trade) are read to the crew, the Deputy Superintendent seeing that they understand what has been read, and, if necessary, explaining it to them. The master first signs his name in full to the Agreement and Duplicate, and fixes the day and hour the crew are to be on board, which is duly entered on the Agreement: the crew then sign in rotation: the Deputy-Superintendent then attests the execution of the Agreement, and previous to dismissing the crew informs them when they are to be on board. When all the arrangements are completed, and all the necessary papers signed and attested, the master will receive from the Deputy-Superintendent the Ship's papers, together with the Certificates, Indentures and Discharges of the crew, and all requisite forms; also the Clearance Certificate to be produced to the Collector and Comptroller of Customs.

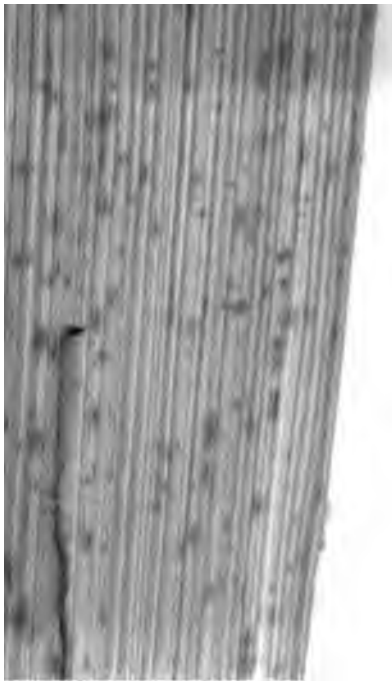
When about to sail, nail a copy of the Victualling Scale in the forecastle, where it can be seen by the crew; also muster the crew to ascertain if all are on board; if any are missing, ship others in their places: when the Pilot leaves give him a copy of the Articles to take to the owners, with a list of the deserters and their substitutes.

', the crew must be discharged at a Shipping
he completion of the voyage, and "an account
must (under a penalty not exceeding £5) be
nd delivered to each member of the crew, at
ours before he is paid off, and no deduction
wed unless duly inserted." On the given day
off, "Discharges" being ready for delivery, the
muster at the Office; the master will first sign
se," and as the men are paid off, they will sign it
tion, each receiving from the Deputy Superin-
s discharge. You will also have to give an
the wages and effects of all deceased seamen.

ew or any portion of them are to be discharged
l there is no Shipping Office, it must be done
Consul.

aman has a lien on the ship for his wages.

no *authorized* VICTUALLING SCALE; whatever
agrees to, they must abide by, but the articles
l must be served out in the proper quantities,
e entitled to compensation; the following scale
lgated by the Committee of the General Ship-
ciety in 1844.



Sun
Mo
Tue
Wed
Thu
Fri
Sat

Sunt
Moni
Tuesi
Wedn
Thur
Frida
Satur

Totals

When
per day.

Subst
¼ oz. of
Molass
1 lb. do

Caution respecting *Lime Juice*:—By the Merchant Shipping Act, 7 & 8 Vict. c. 112, s. 18,—Lime or lemon juice, sugar, and vinegar, are to be served out to the crew, whenever they shall have been consuming salt provisions for *ten days*. The lime or lemon juice and sugar daily, after the rate of half an ounce of each per day, and the vinegar weekly, at the rate of half a pint per week to each person, so long as the consumption of salt provisions be continued.

SHIP'S LOG-BOOK.—The ship's log-book kept and written up daily by the chief-mate, and signed by the master, should receive more attention than is ordinarily bestowed upon it, for it is impossible to say at what time it may be required as evidence in a court of law; besides which, the remarks in it are the foundation of the master's protest, and consequently they should be strictly correct. The remarks should describe most particularly the wind and weather, and the effect on the ship as regards any accidents that may arise therefrom,—the amount of damage sustained and the cause to which it may justly be attributed, as far as can be ascertained at the time; the latitude and longitude; the hour of occurrence; the attention given to the pumps, and to the lead-line, &c. All interlineations and erasures should be avoided; and if any correction is necessary while writing it, make it by drawing the pen through the error.

It is also requisite that the log-book should be properly written up by the time the ship arrives at the Port of destination, ready to be produced when asked for, as in

case of damage to ship or cargo, serious difficulties may otherwise be experienced in the settlement of average.

These requirements are especially necessary; for in many foreign Ports, the Notary Public, on receiving the log-book, may examine any two of the crew privately and separately on the statements therein, before receiving the master's protest; and again, in some Ports it is required by the authorities that the ship's officers, on arrival, should sign the page where the writing ends, for the purpose of preventing any subsequent additions.

A master is allowed to use any form of log-book he prefers.

THE OFFICIAL LOG-BOOK of the voyage for certain special entries, must also, by the Merchant Shipping Act, be kept by every ship master, who is further required within 48 hours after the ship's arrival at her final Port of destination in the United Kingdom, or upon the discharge of the crew, whichever happens first, to deliver it to the Shipping master, before whom the crew is discharged. Full and ample instructions will be found in the first pages of that book, for filling up all the various entries: it is unnecessary, therefore, to give them here in detail, beyond stating that they relate to the name of the ship and official number; name of the master; the voyage; a list of the crew, stating the conduct, character, and qualification of each man; a list of the passengers; an entry of all offences, convictions, punishment, fines, illness or injuries, medical treatment, deaths, births, and marriages, wages of seamen entering the Royal Navy, wages and sale

of the effects of any seaman who may die during the voyage, collisions, and the circumstances under which the same have occurred.

N.B.—Neglect to comply with the requirements specified entails a penalty, and ignorance is not held to be a justifiable plea for such negligence.

It may, however, be incidentally noticed that special attention must be given to make particular and correct *entries of wages and effects of deceased seamen;* and when a man commits an offence, no deduction from his wages on that account can be made unless there is an entry of the date, ship's position, and charge made against him; the entry having been made, then read the charge to the man in the presence of the mate or a witness, stating in writing that you have so read it; sign it, and let the mate sign as witness; call upon the man for his defence, and if he make any, write it under the offence; then sign again as before.

BLANK FORMS

OF THE

PRINCIPAL PROBLEMS

IN

NAUTICAL ASTRONOMY;

ACCOMPANIED WITH BRIEF EXPLANATORY REMARKS.

BLANK FORMS OF THE PRINCIPAL PROBLEMS IN NAUTICAL ASTRONOMY.

Given Ship Date and Long. to find Greenwich Date.

	D.	H.	M.	S.	
M. T. at Ship	...	...	...	...	
Long. in Time		...	...	..	add if W., sub. if E.
M. T. at Green.	..	...	...	...	

Given Greenwich Date and Long. to find Ship Date.

	D.	H.	M.	S.	
Green. Date M. T.	...	...	...	...	
Long. in Time		...	...	...	sub. if W., add if E.
M. T. at Ship	...	...	...	...	

To convert Civil into Astronomical Time:—If the Time is P.M., the Civil and Astronomical Dates are alike; but if the Civil Time is A.M., add 12 to the hours and diminish the day by 1.

To correct Sun's Declination:—Diff. in 1h. × No. of hours, &c. since that noon.

To correct Equation of Time:—Diff. in 1h. × No. of hours, &c. since that noon.

To correct Chronometer:—Daily rate × No. of days = Accumulated rate.

For Polar Distance:—If Lat. and Decl. are of same name, sub. Decl. from 90°; if of different names add 90° to the Decl.

N. A. in the following pages stands for Nautical Almanac.

To correct Sun's Obs. Alt., &c.

	°	′	″
Sun's Obs. Alt.	...	...	...
Ind. Er. + or	—	...	...
	...	...	...
(Eye) Dip	—	...	...
	...	...	...
Ref. in Alt.	—	...	...
	...	...	...
Semid (N.A.)	+	...	...
Par. in Alt.	+	...	

Sun's True Alt. ... (N. or S.)

Sub. from 90

for Zen. Dist. ... (S. or N.)

To correct Star's Obs. Alt., &c.

	°	′	″
*Obs. Alt.	...	...	...
Ind. Er. + or	—	...	...
	...	...	...
Dip.	—	...	...
	...	...	...
Ref.	—	...	...
*s True Alt.	...	...	... (S. or
sub. from	90		
for Zen. Dist.	...	...	... (N. o

Zen. Dist. is always of the same name as observer's N. when he is N. of object; S. when he is S. of the object.

... Meridian Zen. or Meridian Altitude of the Sun when the Ti...

	°	′	″
Sun's Decl. (N.A. p I.)	...	...	...
Cor. for Gr. Date			
Corrected Decl.	...	...	...

Approx. Time of Sight ... h ... m ... s

Long. in Time ...

Gr. Date Appr. Time ...

	° ′ ″		
Obs. Alt. Sun's l. l.	... ...		
Dip	−		
	... ...		
Ref. in Alt.	—		
	... ...		
Semid. (N.A.)	+		
Par. in Alt.	+ ...		
True Alt. Sun's cent.	... ...	(N. or S.)	
	90		
Sun's Zen. Dist.	... ...	(S. or N.)	add if both are N., or both S., otherwise take their difference.
Decl.	... ...	(S. or N.)	
Latitude (see below)	... ...		

The Lat. is S. if both Zen. Dist. and Decl. are S., or N. if both are N.; but of the same name as the greater when one is N., and the other S.; also if Decl. is 0 Zen. Dist. is the Lat.

Lat. from Mer. Alt. of Moon above the Pole.

	H M		° ′ ″
Mer. pass. at Gr. (N.A.)	... ...	Moon's Decl. (N.A.)	... ...
Cor. for Long.	...	Cor. for min. of Gr. D.	... ...
Mer. pass. at Ship	... ...	Cor. Decl.	... ...
Long. in Time	... ...		
Gr. Date, M. T.	... ...		
	′ ″		′ ″
Moon's semid. (N.A.)	... ...	Moon's Hor. Par. (N.A.)	... ...
Cor. + or −	...	Cor. + or −	...
	... ...		... ...
Augmentation	+ ...	Red. for Lat.	— ...
Moon's cor. Semid.	... ...	Moon's red. Hor. Par.	... ...

	°	′	″	
Moon's obs. Alt.	...	...	...	
Dip.	−	...	...	
	...	...	...	
Aug. Semid.		...	...	+ for Ll., − for u.
	...	...	...	
Par. in Alt. − Ref. = Cor. of Alt.	+	...	...	
True Alt., Moon's cent.	...	...	...	(N. or S.)
	90	...	...	
Zen. Dist.	...	...	...	(S. or N.)
Decl.	...	...	...	(S. or N.)
Latitude	...	...	...	

add if are N both other take differe

To name the Lat., *see* Lat. by Sun, p. 568.

Lat. by Mer. Alt. of Star above Pole.

	°	′	″	
Star's obs. Alt.	...	...	...	
Dip.	—	...	...	
	...	...	...	
Ref.	—	...	...	
Star's true Alt.	...	...	...	(N. or S.)
	90			
Zen. Dist.	...	...	...	S. or N.
Star's Decl. (N.A.)	...	...	...	S. or N.
Lat.	...	...	...	(see Lat. by Sun p. 5

Lat. by Sun near the Meridian.

	D.	H.	M.	S.			
Time by Watch	.	...	..	...	Sun's Decl. (N. A. p. 1)	...	...
Error + or −			...	...	Cor. for Gr. Date		...
Approx. T. at Ship	.	...	...	...	Cor. Decl.	...	...
Diff. Long. made			...	...	(+ if E., − if W.)		
App. T. at Ship	.	...	...	...			
Long. in time		...	...	...			
Gr. Date, App. T	.	...	...	...	From the observed		

obtain the True Alt. as bef

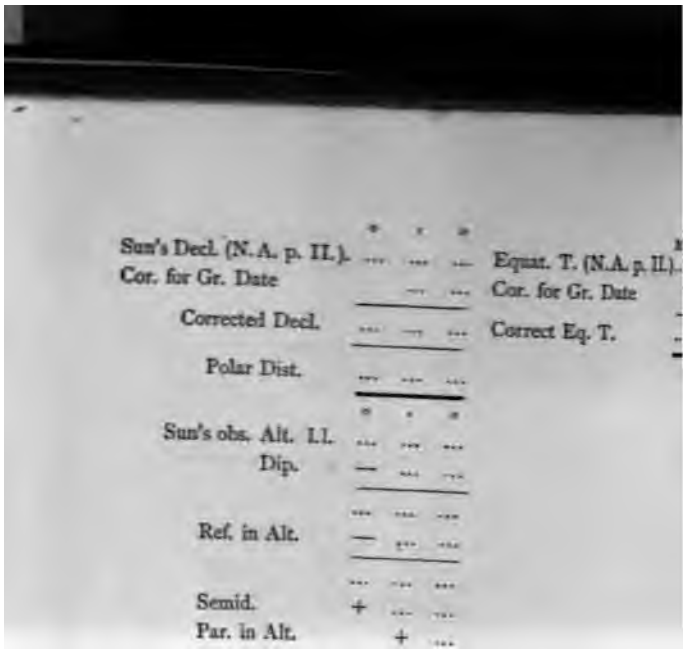
	M s		Constant Log. 0·301030
Time from Noon	... ...	Log Hour	∠ * .....
	° ′		
Lat. by D. R.	... ...		cos. .....
Decl.	... ...		cos. .....
† Mer. Zen. Dist.	... ...		cosec. .....
	′ ″		
Reduction	+		sin. .....
True Alt.	... ...		
Red. Alt.	... ...	(N. or S.)	
	90		
Mer. Zen. Dist.	... ...	(S. or N.)	
Decl.	... ...	(S. or N.)	
Lat.	... ...	(*see* Mer. Alt., p. 568.)	

* Or, Log. sine square of Raper.

† For Mer. Zen. Dist., take sum of Lat. and Decl. when they have different names ; if they have the same name take their difference.

Longitude by Chronometer from Alt. of Sun.

	D. H. M. S.	
Time by Chron.	... ...	
Orig. Error + or −	... ...	add if slow, sub. if fast.
	... ...	
Rate × elapsed time	... ...	add if losing, sub. if gaining.
Green. Date, M.T.	... ...	



Sun's Decl. (N.A. p. II.).	...	...	...
Cor. for Gr. Date		...	...
Corrected Decl.	...	...	...
Polar Dist.	...	...	...
Sun's obs. Alt. L.L.	...	...	...
Dip.	—	...	...
Ref. in Alt.	...	...	...
	—	...	...
Semid.	...	...	...
Par. in Alt.	+	...	...
True Alt.	...	...	...
Lat.	...	...	...
Pol. Dist.	...	...	...
Sum.	...	...	...
½ sum.	...	...	...
½ sum—Alt.	...	...	...

Equat. T. (N.A. p. II.).
Cor. for Gr. Date
Correct Eq. T.

sec. . .....
cosec. . .....
cos. . .....
sin. . ...

	D.	H.	M.	S.	
† If P.M., App. T. Ship	...	...	...	...	log. of hour . . ..
Eq. T.			...	...	+ or − (*see* N. A. p. I
M. T. at Ship	...	...	...	...	diff.
Gr. Date, M. T.	...	...	...	...	
Long. in T.		...	...	...	= ... ... W. if Gr.

is best; but I
if Gr. T. is less

* Or, Log. sine square of Raper.

† If A.M. obs., sub. the hour angle from 24 h. before you apply the Equation of Time.

Long. by Chron. from Alt. of Star or Moon

	D	H	M	S		H	M	S
by Chron.	.	...	...	...	Star's R.A. (N.A.)	...	...	...
						°	′	″
Er. (+ or −)			...	...	Star's Decl.	...	...	...
	.	...	...	...		90		
n. rate (+ or −)			...	...	Pol. Dist.	...	...	..
ıate, M.T.	.	...	...	...				

	H.	M.	S.		°	′	″			
ıl Time p. II)	...	...	...	Stars' obs. Alt.	...	...	...			
eration :. Date		...	...	Dip.	—	...	...			
un's R.A.	...	...	...		...	...	...			
				Ref.	—	...	...			
				Star's True Alt.	...	...	...			
				Lat.	...	...	...	sec.	.	.....
				Pol. Dist.	...	...	...	cosec	.	.....
				sum.	...	...	...			
				½ sum.	...	...	...	cos.	.	.....
				½ sum − Alt.	...	...	...	sin.	.	.....
* Star's W. mer. dist			...	... ..	Log. of hour ∠				.	.....
Star's R.A.			...	... ...	(add)					
R.A. of Mer.			...	... ...						
Mean Sun's R.A.			...	... ...	(sub. borrowing 24h. if necessary.					
Ship' Date, M.T.	.	...	...	... }	diff.					
Gr. Date, M.T.	.	...	...	... }						
					°	′	″			
Long. in Time			...	... ... =	...	...	...			

ıe star is E of the meridian, subtract its mer. dist. or hour angle
ɔm 24h. before adding its R.A.

Variation of Compass from Amplitude.

	D	H	M	s		°	′	″
App. T. at Ship					Sun's decl. (N.A. p. I.)			
Long. in time					Cor. for Gr. Date			
Gr. Date, App. T.					Cor. decl.			

	°	′	″		
Decl.				sine	sum
Lat.				secant	

	°	′	″		
* True Amp. (E. or W.)				(N. or S.) sine	

Mag. Amp.

\+ Variation (E. or W.)

* Name the true amp. E when rising, W when setting, towards N. or S. according to Decl.

\+ If true amplitudes are both N. or both S., take their diff.; if one is N. and the other S., take their sum for the variation; also, the variation is E. if true amp. is to right, but W. if to left of magnetic amplitude.

Variation of the Compass from an Azimuth.

	D	H	M	s		°	′	″
M. T. at Ship					Obs. Alt. Sun's l.l.			
Long. in T.					Dip			
Greenw. Date, M. T.								
					Ref.			

	°	′	″				
Decl. (N.A. p. II.)							
Cor. for Gr. Date				Semid.	+		
Cor. Decl.				Par.	+		
Pol. Dist.				Tr. Alt.			

[redacted]

	°	′	″		
Tr. Alt.	...	...	...	sec.	.....
Lat.	...	...	...	sec.	.....
Pol. Dist.	...	...	...		
Sum	...	...	...		
½ Sum.	...	...	...	cos.	.....
½ Sum ~ Pol. Dist.	...	...	...	cos.	.....
					2).....
	°	′	″		
½ Azimuth	...	...	...	sin.	.....
				2	
Tr. Azimuth	...	...	...		
Obs. Azimuth	...	...	...		
Variation	...	...	...		

If Tr. Az. and Obs. Az. are both N. or both S., their Diff. is the Var.; if one is E. and the other W., take their sum.

N.B.—The Tr. Az. is reckoned from N. in S. Lat., and from S. in N. Lat; towards E. when Alt. is increasing, but towards W. when Alt. is decreasing. Also, when one Az. is N. and the other S., subtract Tr. Az. from 180°.

The Var. is E. if Tr. Az. is to the right, but W. if Tr. Az. is to the left of magnetic Az.

This form is equally applicable to a Star Azimuth.

Lat. by Mer. Alt. below the Pole.

To true Alt. of object's centre add its Polar Dist.

N.B. When *above* the pole, the object rises until on the meridian; when *below* the pole, it descends until on the meridian.

Form to compute Lat. by Double Alt.

½ Elaps. T.	sin.	. .....				
Pol. Dist.	sin.	. .....	cos.	. .....		
Arc. A.	sin.	. .....	sec.	. .....	cosec.	. .....
Arc. B.	...	... ...	cos.	. .....		
Arc. A.			sec.	. .....		
½ sum. Alt.			sin.	. .....	cos.	. .....
½ diff. Alts.			cos.	. .....	sin.	. .....
Arc. C.			sec.	. .....	sin.	. .....
Arc. D.	...	... ...	cos.	. .....		
Arc. E.	...	... ...	cos.	. .....		
Arc. C.			**cos.**	**. .....**		
Approx. Lat.	...	... ...	sin.	. .....		

Arc. B. is of the same affection as the Pol. Dist.

Take arc D from arc B, for arc E., except in Tropical Lats. where if Lat. and Decl. are of same name, and Lat. less than De take sum of B and D. for E.

To compute an Altitude.

Object's Hor. Ang.	... ...	cos.	. .....	
Lat.	... ...	cot.	. .....	sin. . .....
Arc. I	... ...	tan.	. .....	sec. . .....
Pol. Dist.	... ...			
*Arc. II.	... ...			cos. . .....
True Alt.	... ...			sin. . .....

*Arc. II. is the diff. of Arc. I. and Pol. Dist., unless the obje hour angle is more than 6h. or 90°, in which case take their sum.

Lunar.—Form to compute the True Distance.

	°	′	″		
Sun (or Star's) App. Alt.	...	...	...	sec.	.....
Moon's App. Alt.	...	...	...	sec.	.....
App. Dist.	...	...	...		
Sum,	...	...	...		
½ sum.	...	...	...	cos.	.....
App. Dist. ~ ½ sum = Diff.	...	...	...	cos.	.....
Sun (or Star's) True Alt.	...	...	...	cos.	.....
Moon's True Alt.	...	...	...	cos.	.....
Sum of True Alts.	...	...	...	2)	.....
sum of True Alts. = Arc. I	...	...	...		
Arc. II	...	...	...	sin.	.....
(Arcs. I and II) Sum.	...	...	...	cos.	..... } sum.
,, Diff.	...	...	...	cos.	..... }
				2)	... .
	°	′	″		
½ True Dist.	...	...	..	sin.	. .....
			2		
True Dist.	...	...	...		

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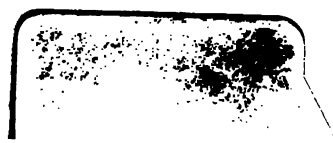
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